INSTITIÚID ARD-LÉINN BHAILE ÁTHA CLIATH
(Dublin Institute for Advanced Studies)

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ANNUAL REPORT
1976

10 Burlington Road, Dublin 4

Prl.8797

INSTITIÚID ARD-LÉINN BHAILE ÁTHA CLIATH
(Dublin Institute for Advanced Studies)

Annual Report of the work of the Institute and its Constituent Schools presented by the Council to the Minister for Education in respect of the year ended 31 December 1976

Prl.8797

INSTITIÚID ARD-LÉINN BHAILE ÁTHA CLIATH
(Dublin Institute for Advanced Studies)

Summary of Annual Report
of the work of the Constituent Schools
for the year ended 31 December 1976

School of Celtic Studies

Research continued on Irish texts, laws, history, dialects and bibliography. Cataloguing of Irish manuscripts in the National Library of Ireland progressed and the work of cataloguing Irish manuscripts in Cambridge libraries and in Scotland is almost complete. Arrangements were made and work started on cataloguing of Irish manuscripts in diocesan colleges and in minor collections throughout Ireland. Work was also carried out in the fields of Breton, Welsh and Scottish Gaelic.

Six new works were published and nine were reprinted. Twenty-four articles by members of the staff and by scholars of the School were published in periodicals, and three volumes edited by staff members were published outside the School. Parts 25, 26 and 27 of Roparz Hemon's Historical Dictionary of Breton were published in Rennes.

Seminars in specialised subjects were conducted by members of the staff throughout the year, and a symposium, at which seven papers were presented, was held in March.

The Statutory Public Lecture was delivered by Mr. Fergus Kelly on 'Early Irish Justice', on 26 November 1976 in University College, Dublin.

School of Theoretical Physics

A colloquium on Rotational Brownian Motion was held and attracted thirty participants from Irish Universities and from abroad.

The School continued its research in the areas of general relativity, statistical mechanics, Lie Groups and high-energy physics. Thirty-six papers were published during the year. Members of the School attended thirty-one international conferences and gave thirty-five lectures in other institutions. Twenty-eight scientists from abroad visited the School (apart from those attending the colloquium).

Events which were continued from the previous year were the Wednesday seminars, the Christmas and Easter symposia, and various weekly meetings held jointly with the universities. The joint UCD-TCD-Maynooth-DIAS post-graduate course was continued.

The Statutory Public Lecture was given in Trinity College, Dublin on 17 December 1976 by Professor Lewis.

School of Cosmic Physics

Astronomy Section:

Material on faint cepheid variable stars in the large Magellanic Cloud was partly prepared for publication. Agreement of the brighter stars with other photo-electric results has been closely examined and further investigation of stability of periods is being planned.

Intermediate-latitude OB star data were analysed in respect of spiral forms; the local arm appears to reach 500 parsecs above the galactic plane.

The correspondence between possible Galactic Centre flashes of optical radiation and a "burst X-ray source" was investigated.

Optical and infrared observations on asteroids were carried out on Tenerife with the purpose of estimating bolometric sizes of several of these objects.

Analysis of orbital elements of Halley's Comet has been directed towards establishing whether a close encounter with Jupiter can be assigned a statistical probability as an historical occurrence.

Cosmic Ray Section:

The study of the ultra heavy component of the Cosmic Radiation was continued during the year. All the ultra heavy cosmic ray nuclei found to date were re-examined and re-analysed using a new parameter for the rate of charge of ionisation and a new expression for restricted energy-loss. The Bristol-Dublin collaboration has now assembled the world's largest sample of ultra heavy cosmic ray events obtained from thick detectors.

During the year work began on a project to determine the elemental abundances in the transcobalt region of the Cosmic Radiation where experimental investigation is very difficult. In addition a ground level monopole detector system, with a collecting area of about a hundred square metres, was deployed.

The study of the application of biquaternions to the motion of charged particles in an electromagnetic field has been continued and a new way of formulating supraluminal transformations has been developed.

The interactions of 300 GeV and 400 GeV protons produced by the Batavia accelerator were studied in nuclear emulsion and the work on multiple coulomb scattering of heavy ions has been completed.

Geophysics Section:

The complex structure of the Lee Valley in Co. Cork was investigated and the findings indicate that this valley marks an abrupt change in the geological basement beneath the Carboniferous and Devonian strata.

Two areas of magnetic activity near Strokestown and New Ross were analysed. The former was probably the site of island arc volcanic activity. The latter area and findings are possibly of commercial interest.

The year marked the start of active marine magnetic work by members of our staff. The areas concerned were around the south east corner of Ireland and off Dublin from Skerries to Bray. Besides showing expected results new ones included the surprising fact that the coast of Waterford

from Stradbally to Tramore forms the northern edge of a graben structure.

The course of lectures on Geophysics was given to students from the Dublin and Cork Universities in the Michaelmas Term and field exercises for an earlier class of students were conducted in the summer.

The Statutory Public Lecture was given by Dr. H. I. S. Thirlaway on 10 December 1976 in Trinity College, Dublin.

INSTITIÚID ÁRD-LÉINN BHAILE ÁTHA CLIATH
(Dublin Institute for Advanced Studies)

Annual Report of the work of the Institute and its Constituent Schools presented by the Council for the year ended 31 December 1976

In accordance with the provisions of Section 29 of the Institute for Advanced Studies Act, 1940 (No. 13 of 1940), the Council of the Institute has the honour to present to the Minister for Education for submission to the Government a report of the work and activities of the Institute and its Constituent Schools for the year ended 31 December 1976.

The general purpose which it is hoped to accomplish is clearly stated in the Act establishing the Institute, namely, the Institute for Advanced Studies Act, (No. 13 of 1940) and in the Establishment Orders establishing the three Constituent Schools, namely, the Institute for Advanced Studies (School of Celtic Studies) Establishment Order, 1940, the Institute for Advanced Studies (School of Theoretical Physics) Establishment Order, 1940, and the Institute for Advanced Studies (School of Cosmic Physics) Establishment Order, 1947, and need not be referred to here. It is deemed desirable, however, to include in the report for the purposes of record certain particulars about the constitution of the Council of the Institute and the membership of the Governing Boards of the three Constituent Schools on the 31st December 1976.

The report is presented under the following principal heads:-

I - Constitution of the Council of the Institute and of the Governing Boards of the three Constituent Schools on the 31st December 1976.

II - Report of the Governing Board of the School of Celtic Studies.

III - Report of the Governing Board of the School of Theoretical Physics.

IV - Report of the Governing Board of the School of Cosmic Physics.

I - Constitution of the Council of the Institute and of the Governing Boards of the three Constituent Schools on the 31st December 1976.

1. THE COUNCIL OF THE INSTITUTE

Chairman:

Professor W. B. Stanford, M.A., Litt.D., S.F.T.C.D.

Ex-Officio Members:

Thomas Murphy, M.D., D.P.H., B.Sc.Pub.H., President, University College, Dublin; Francis S. L. Lyons, M.A., Ph.D., Litt.D., F.B.A., Provost, Trinity College, Dublin; George F. Mitchell, M.A., D.Sc., President, Royal Irish Academy.

Members appointed by the Governing Boards of Constituent Schools:

Professor Brian Ó Cuív, M.A., D.Litt.; T. K. Whitaker, D.Econ.Sc.; Professor J. T. Lewis, B.Sc. Ph.D.; Dr. A. J. McConnell, M.A., M.Sc., Sc.D., F.T.C.D.; Professor T. Murphy, D.Sc.; Professor E. F. Fahy, M.Sc., Ph.D.

2. GOVERNING BOARD OF THE SCHOOL OF CELTIC STUDIES

Chairman:

Proinsias Mac Cana, M.A., Ph.D.

Senior Professors:

James P. Carney, B.A., Fil.Dr.; David Greene, M.A.; Brian Ó Cuív, M.A., D.Litt.

Appointed Members:

Máirín Bean Uí Dhálaigh, M.A., D.Litt.Celt.; Tomás de Bhaldraithe, M.A., Ph.D., D.Litt.; James H. Delargy, M.A., D.Litt., Litt.D.; Gearóid Mac Eoin, M.A., Ph.D.; Monsignor Tomás Ó Fiaich, M.A., Lic.Hist.Sc.; Seán Ó Tuama, M.A., Ph.D.; Ernest Gordon Quin, M.A., F.T.C.D.; Gerard Victory, B.A., Mus.D.; Thomas Kenneth M. Whitaker, D.Econ.Sc.

3. GOVERNING BOARD OF THE SCHOOL OF THEORETICAL PHYSICS

Chairman:

Albert J. McConnell, M.A., M.Sc., Sc.D., F.T.C.D.

Senior Professors:

John T. Lewis, B.Sc., Ph.D.; Reverend James R. McConnell, M.A., D.Sc.; Lochlainn O Raifeartaigh, M.Sc., Ph.D.

Appointed Members:

Michael A. Hayes, M.Sc., Ph.D.; Thomas E. Nevin, D.Sc.; Patrick Quinlan, B.E., D.Sc., Ph.D.; Thomas D. Spearman, M.A., Ph.D. (Cantab.); Seán Seosamh Tóibín, M.Sc., Ph.D.; William Wright, M.A., Ph.D., Sc.D., C.Eng., F.I.C.E., F.Inst.Prod.E., F.I.E.I., F.R.S.E.

4. GOVERNING BOARD OF THE SCHOOL OF COSMIC PHYSICS

Chairman:

Edward Francis Fahy, M.Sc., Ph.D.

Senior Professors:

Cormac Ó Ceallaigh, M.Sc., Ph.D.; Thomas Murphy, D.Sc.; Patrick Arthur Wayman, Ph.D.

Appointed Members:

Patrick M. A. Bourke, M.Sc.; Peter Kevin Carroll, M.Sc., Ph.D.; Brian Henderson, B.Sc., M.A., Ph.D., F.I.P.; George F. Imbusch, Ph.D., D.Sc.; Reverend Thomas P. G. McGreevy, M.Sc., Ph.D.; Patrick Nolan, Ph.D., D.Sc.; Neil A. Porter, Ph.D.; Ernest T. S. Walton, M.A., M.Sc., Ph.D., D.Sc., F.T.C.D.

5. ADMINISTRATIVE STAFF

Registrar:

Patricia O'Neill.

Senior Clerk:

Maura Devoy.

Accounts Clerk:

Mary A. O'Rourke.

Clerks:

Angela Stubbs; Noreen Granahan; Desmond Pender.

II - Annual Report of the Governing Board of the School of Celtic Studies for the year ended 31 December 1976 adopted at its meeting on 6 May 1977.

1. STAFF, SCHOLARS AND EXTERN RESEARCH WORKERS

Professor Emeritus:

D. A. Binchy.

Senior Professors:

Brian Ó Cuív, Director of the School; James Carney; David Greene.

Professor:

Breandán Ó Buachalla.

Assistant Professors:

Pádraig de Brún; Fergus Kelly; Rolf Baumgarten.

Assistants (Part-time):

Mrs. Nessa Doran; Mrs. Anne O'Sullivan.

Research Assistant:

Míchéal Ó Siadhail.

Research Associates:

Proinsias Mac Cana; Heinrich Wagner; Gearóid Mac Niocaill.

Technical and Clerical Staff:

Máire Breatnach; Máire Bean Uí Chinnseala.

Scholars:

Liam Breatnach (to 31 May 1976); Malachy McKenna (to 31 October 1976); Anders Ahlqvist (to 31 December 1976); John Armstrong III; Kay Muhr (to 30 September 1976); Pádraig Ó Ciardha; Liam Ó Murchú; Virginia Blankenhorn (from 1 October 1976); Christopher McAll (from 1 October 1976); Kim Robert McCone (from 1 October 1976); Nancy Stenson (from 1 October 1976).

Extern Research Workers:

Dr. Cecile O'Rahilly; M. Louis Paul Nemo (Roparz Hemon); Dr. Ludwig Bieler; Tomás Ó Cathasaigh; Mr. Ronald Black; Dr. Brian Murdoch; Mr. Eurys I. Rowlands; An tAthair Pádraig Ó Fiannachta; Dr. Nancy Dorian; Professor Pádraig Ó Riain; Donncha Ó hAodha; Dr. Joan Radner.

In recent years a modest expansion of the staff of the School has been sought, but to no avail. At the end of 1975 negotiations were begun with officials of the Department of Education with a view to suspending, as a temporary expedient, an existing post of Professor and substituting for it two posts at the level of Research Assistant, thus bringing to four the number of full-time Assistants in the School. It was hoped that this

would be readily agreed to by the Ministers concerned and that recruitment to the new posts could be proceeded with at the same time as that to the existing post of Research Assistant which was left vacant through the promotion of Mr. R. Baumgarten. Unfortunately unforeseen delays took place in our negotiations with the Department of Education, with the result that the year ended without our being in a position to strengthen the academic staff in the way we had planned.

2. RESEARCH AND EDITING

Professor D. A. Binchy continued the insertion of cross-references on the proofs of Corpus Iuris Hibernici. Three hundred pages were sent to the printers for final revision. An article entitled 'Irish History and Irish Law II' was accepted for publication in Studia Hibernica. See also Section 7.

Professor Brian Ó Cuív continued work on Irish metrics, on literary and linguistic topics and on his contributions for A New History of Ireland; he began an examination of the manuscript sources of the poems in T. F. O'Rahilly's Dánta Grádha; he corrected revised proofs of Dán na mBráthar II and prepared the material necessary to complete the volume; in his capacity as Editor of Celtica he prepared for the printers the copy for Vol. XII. The following articles by him were accepted for publication: (i) 'Some Possible Congeners of English Slang "to sock" (Word); (ii) 'The Wearing of the Green' (Studia Hibernica); (iii) 'The Earl of Thomond and the Poets, A.D. 1572' (Celtica). See also sections 4, 5, 6 and 7.

Professor James Carney worked on the earliest Irish verse. See also sections 4, 6 and 7.

Professor David Greene continued work on Saltair na Rann. He began work on a text-book on the history of the Irish language, to be written in Irish. An article entitled 'The Act of Truth in a Middle Irish Story' was accepted for publication in Saga och sed (Uppsala) 1977. See also sections 4, 5, 6 and 7.

Professor Breandán Ó Buachalla continued his survey of sources for the history of Irish in Ulster which entailed several visits to libraries in Belfast. He completed his study of ní and cha in Ulster Irish and began an article on 'Vision' poetry in Ulster. Field-work continued on the dialect of Cape Clear, Co. Cork. An article entitled 'Ní and cha in Ulster Irish' was accepted for publication in Ériu. See also sections 6 and 7.

Pádraig de Brún continued to work in collaboration with Máire Herbert on a catalogue of Irish manuscripts in Cambridge. An article entitled 'Lámhscribhinní Gaeilge i Ros Cré' was accepted for publication in Éigse. See also section 7.

Mr. Rolf Baumgarten continued research towards the completion of the Bibliography of Irish Linguistics and Literature, 1942-71, and its concurrent indexes. See also section 7.

Mícheal Ó Siadhail completed work on a collection of terms from Inis Meáin and continued work on an introduction to the Irish of Cois Fhairrge. See also section 7.

Mr. Fergus Kelly continued work on an edition of the Old Irish Bee-Laws (Bechbretha) and on the Irish parts of Dr. Bieler's edition of The Patrician Texts in the Book of Armagh. See also sections 3 and 4.

Mrs. Nessa Doran checked proofs of Fasciculus III of A Catalogue of Irish MSS. in the National Library of Ireland and completed the preparation of Fasc. IV which was sent to the printer in December 1976. MSS. G 161-G 176 for Fasc. V were catalogued. A microfilm of the Cambridge MSS. was examined for Pádraig de Brún with a view to identifying some hands.

Mrs. Anne O'Sullivan checked the Concordance to Corpus Iuris Hibernici for Professor Binchy and completed the preparation of Volume VI of the Book of Leinster. See also section 6.

Liam Breatnach, whose scholarship terminated on 31 May 1976 to allow him to take up an appointment as lektor für keltische Sprachen at Sprachwissenschaftliches Institut der Universität Bonn, continued work on an edition of the Middle-Irish text 'Tochmarc Luaine ocus Aided Athairne'.

Dr. Malachy McKenna continued work on a Morphology of the Breton of Guémené-sur-Scorff. He assisted Roparz Hemon with the correction of proofs of Doctrin an Christenien. The following articles were accepted for publication in Zeitschrift für Celtische Philologie:- (i) 'Index to the Breton of Guémené-sur-Scorff, part I'; (ii) 'The use of the Article in the Speech of Guémené-sur-Scorff'. A review of Allegroregeln rechtfertigen Lentoregeln by W. Dressler was accepted for publication in Celtica XII. Dr. McKenna was appointed as a temporary lecturer in the Department of Celtic at Queen's University, Belfast, from 1 November 1976 while Professor Wagner was on sabbatical leave. See also section 7.

Dr. Anders Ahlqvist continued work on the Auraicept na nÉces, attempting to isolate the original text on the basis of all known manuscripts. The work progressed sufficiently for most of this canonical text to be edited and translated; a major part of the introduction has also been completed. An article entitled 'On the position of Pronouns in Irish' could not be published in Scottish Studies as proposed but was accepted instead for publication in Éigse. An article on 'Oratio Dominica "Waldensis"' was accepted for publication in Studia Celtica 12 and one entitled 'A propos des Adverbes vieil-irlandais en -ith, -id' for Etudes celtiques 15. See also sections 5 and 7.

Mr. John Armstrong continued work on a Ph.D. thesis 'Syntax of the VN in Modern Irish prose 1600-1650' and on the hitherto unpublished grammatical tracts and also on the trefhocal and related material in Auraicept na nÉces and began preparation of an edition of the Old Irish poem Tuathal Techtmar ba rí Temrach. See also section 7.

Miss Kay Muhr continued research for her Ph.D. thesis on 'The development of style in traditional Gaelic narrative, with special reference to "runs"'. Work began towards the editing of the accounts of the inundation of Lough Neagh and the collection of related legends.

Pádraig Ó Ciardha studied manuscripts which contain the poetry of Toirdhealbhach Ó Cearbhalláin and transcribed from the manuscripts in R.I.A., N.L.I., St. Patrick's College, Maynooth and U.C.G. He attempted to assess the manuscript tradition of the poetry and began work on an edition. An article entitled 'Nóta ar an bhfocal "mnigh"' was accepted for publication in Éigse. See also section 7.

Liam P. Ó Murchú continued to work on the collation of manuscripts of Cúirt an Mheán Oíche. Work began on the editing of a series of Clare poems which are related in subject matter to the Cúirt and which provide an opportunity to practise methods of editing poems of the modern period. See also section 7.

Miss Virginia Blankenhorn began a preliminary study of intonation

patterns at work in the Irish of Cois Fhairrge and continued an investigation of historical development of Irish song, both musical and textual. An article entitled 'Traditional and Bogus Elements in "Mac Crimmon's Lament"' was accepted for publication in Scottish Studies. See also section 6.

Mr. Christopher McAll continued work on a D.Phil. thesis on 'The Old-Irish law of status'. He completed the revision of a provisional edition of the law-text Uraicecht Becc and incorporated the readings of the T.C.D. Ms. E.3.3.

Mr. Kim Robert McCone worked on a thesis entitled 'Aspects of Indo-European sentence patterns and their role in the constitution of the Old Irish verbal system'. Papers on (i) the absolute and conjunct endings; (ii) the nazalizing object relative clause in the Würzburg and Milan glosses and related matters and (iii) the datives of consonant stems in the glosses and their historical antecedents were submitted to Professor Greene who supervises his work.

Dr. Nancy Stenson spent some time in Rath Cairn, Co. Meath, investigating aspects of the Modern Irish complement system. She began to study Old and Classical Irish and to collect data for research in historical syntax. Work commenced on the revision of the thesis 'Topics in Irish Syntax and Semantics' with a view to future publication.

Dr. Cecile O'Rahilly checked the final proofs of her edition of Táin Bó Cúailnge Recension I and prepared 'Five Notes' for publication in Celtica XII. See also section 7.

M. Roparz Hemon checked proofs of his edition of Doctrin an Christenien which is to be published as Volume IV in the Mediaeval and Modern Breton Series. See also section 7.

Dr. Ludwig Bieler, General Editor of Scriptores Latini Hiberniae, carried in some emendations in the Commentary of his edition of The Patrician Texts in the Book of Armagh at the suggestion of Mr. Fergus Kelly.

Professor Proinsias Mac Cana, General Editor of the Mediaeval and Modern Welsh Series, read final proofs of Eurys Rowlands' edition of The Poems of the Cywyddwyr.

Dr. Gearóid Mac Niocaill worked on proofs of The Annals of Ulster.

Tomás Ó Cathasaigh checked final proofs of The Heroic Biography of Cormac Mac Airt and first proofs of the Index.

Mr. Ronald Black continued his work of cataloguing the Gaelic manuscripts in the National Library of Scotland. He submitted descriptions of the following manuscripts to Professor Greene:- 72.2.8, 72.2.11, 72.2.17 - 25, 73.3.7, 73.3.9, 73.3.12, 73.3.16 - 21. He has also completed and submitted to Professor Greene a description of the relevant section of the archives of the Highland and Agricultural Society of Scotland, which is to be published in the Transactions of the Gaelic Society of Glasgow.

Dr. Brian Murdoch checked proofs of The Irish Adam and Eve Story Vol. II which were passed for press in November 1976.

Mr. Eurys Rowlands checked revised proofs of his edition of The Poems of the Cywyddwyr which were passed for press for publication as Volume VIII in the Mediaeval and Modern Welsh Series.

An tAthair Pádraig Ó Fiannachta compiled a catalogue of Irish manuscripts

in a number of diocesan colleges in Ireland. The material was prepared for press and sent to the printer in December 1976.

Dr. Nancy Dorian completed the preparation of East Sutherland Gaelic. The work was sent to press in May 1976 and first proofs of all material were checked by the author.

Dr. Joan Radner's edition of Fragmentary Annals of Ireland was sent to press in July 1976. First proofs were checked by the author.

Professor Pádraig Ó Riain prepared an edition of Cath Almaine which is to be published as Volume XXV in the Mediaeval and Modern Irish Series. The material was sent to the printer in December 1976.

Donncha Ó hAodha prepared an edition of Bethu Brigte. The material was sent to press in September 1976 and first proofs received in November.

3. STATUTORY PUBLIC LECTURE

A statutory lecture entitled 'Early Irish Justice' was delivered by Mr. Fergus Kelly in University College, Dublin on 26 November 1976.

4. SEMINARS

Professor Brian Ó Cuív held a weekly class on Manuscript Reading and Textual Editing during Hilary and Michaelmas terms.

Professor David Greene's weekly seminar on Saltair na Rann was held during Hilary and Michaelmas terms.

A seminar on the Old Irish law-tract Bechbretha was conducted by Thomas Charles-Edwards and Fergus Kelly during Hilary terms.

Professor James Carney conducted a seminar on A meccucáin, sruith in tíag, an attempted reconstruction of an early Old Irish poem, in Trinity term, and one on Old Irish Poetry during Michaelmas term.

5. SYMPOSIUM

On March 12 and 13 1976 a symposium was held for university and college staff and research workers. The following papers were read:-

Donncha Ó hAodha:	Macghníomhartha Aichil
Brian Ó Cuív:	An deireadh briathardha -síl agus foirmeacha atá gaolmhar leis
Anders Ahlqvist:	Remarks on Auraicept na nÉces
Heinrich Wagner:	The Dind Ríg poem and related problems
David Greene:	Archaic Irish
Dónall Ó Baoill:	An *f* 'do bhean' 'an bhean s'agat'?
Breandán Ó Madagáin:	Anáil na hiasachta ar Amhlaoibh Ó Súilleabháin sa Chín Lae.

6. EXTERNAL ACTIVITIES

Professor Brian Ó Cuív attended: (i) the Conference and Meeting of the Council for Names Studies in Great Britain and Ireland in Edinburgh, 2-5 April 1976; (ii) Éigse Drobhais in Kinlough, 13-15 August 1976.

Professor James Carney delivered a public lecture, under the auspices of the Institute for Irish Studies, on Early Irish Poetry, at Queen's University, Belfast, on 15 November 1976.

Professor David Greene attended the Kolloquium der Indogermanischen Gesellshaft at Bonn from 15 to 17 February and lectured on 'Archaic Irish'. Mr. Rolf Baumgarten and Mr. Fergus Kelly also attended the Kolloquium.

Professor Breandán Ó Buachalla delivered a lecture on '*Ní* and *cha* in Ulster Irish' to the Celtic Department at Queen's University, Belfast, in May.

Mrs. Anne O'Sullivan attended an Advanced Seminar on Mediaeval Palaeography at the University of Durham from 20 to 25 September 1976.

7. PUBLICATIONS

Over the years the publications side of the School's work has grown immensely. We now have published more than 150 books and we are adding to that number at the rate of about six a year, while at the same time we are reprinting earlier publications when necessary. Demand for our books is increasing and over 7,000 volumes were sold during the year. Difficulties in connection with printing seem to grow and there is a consequent strain on those members of the staff who have to deal with these matters as well as attending to their other duties, whether clerical, administrative or academic. Work on preparation of a new catalogue of publications to supersede that issued in 1971 was begun and it is hoped to issue the catalogue in the summer of 1977. The number of new works published in 1976 was six, and nine works were reprinted.

(a) Books published by the Institute:

Celtica Vol. XI (Myles Dillon Memorial Volume). Edited by David Greene and Brian Ó Cuív. pp. 285. £6.00.

Audacht Morainn. Edited by Fergus Kelly. pp. xlvi + 83. £3.75.

Nua-Dhuanaire Cuid II. Edited by Breandán Ó Buachalla. pp. ix + 145. £2.10.

An Teagasc Críosdaidhe. (Scribhinní Gaeilge na mBráthar Mionúr Iml. XII). Feargal Mac Raghnaill a chuir in eagar. pp. xlii + 121. £4.20.

Táin Bó Cúailnge Recension I. Edited by Cecile O'Rahilly. pp. xxiv + 312. £10.50.

Poems of the Cywyddwyr. (Mediaeval and Modern Welsh Series Vol. VIII). Edited by Eurys I. Rowlands. pp. lii + 125. £6.00.

(b) Books published outside the Institute:-

Brian Ó Cuív:

A View of the Irish Language, edited by Brian Ó Cuív. Reprint edition published by Stationery Office, Dublin.

David Greene:

Ériu XXVII. Published by the Royal Irish Academy and edited by David Greene and Proinsias Mac Cana.

Proceedings of the Seventh Viking Congress. Edited by David Greene and Bo Almquist.

Roparz Hemon:

Historical Dictionary of Breton: Rannou 25, 26, 27. (Orgloz-Pwidigezh). Published by Preder, Rennes.

(c) Reprints:

1. O'Rahilly: Desiderius
2. Dillon: Serglige Con Culainn
3. O'Keeffe: Buile Shuibhne
4. O'Brien: Corpus Genealogiarum Hiberniae
5. O'Rahilly: Early Irish History and Mythology
6. O'Rahilly: Irish Dialects Past and Present
7. Thomson: Branwen Uerc Lyr
8. Evans: A Grammar of Middle Welsh
9. Bieler: The Irish Penitentials.

(d) Contributions to periodicals and other publications:

D. A. Binchy:

Fóchem, Fethem, Aigne. Celtica XI, 18-23.

The Pseudo-Historical Introduction to the Senchas Mór. Studia Celtica X-XI, 15-28.

Irish History and Irish Law I. Studia Hibernica 15, 1-36.

Semantic Influence of Latin in the Old Irish Glosses. Latin Script and Letters: Festschrift Ludwig Bieler. 167-173.

Brian Ó Cuív:

Comram na Cloenfherta. Celtica XI, 168-79.

Two Notes. Éigse XVI, 135-44.

Observations on Irish 'clog' and some cognates. Studia Celtica X-XI, 312-7.

An Elegy on Art Óg Ó Néill. Seanchas Ard Mhacha Vol. 8, 34-43.

The Irish Language in the early modern period. Chapter XX (pp. 509-45) of Vol. III of A New History of Ireland (Clarendon Press, Oxford).

James Carney:

The earliest Bran material. Latin Script and Letters, A.D. 400-900: Festschrift Ludwig Bieler. 174-93.

David Greene:

The Diphthongs of Old Irish. Ériu XXVII, 26-45.

Varia II. ibid., 123-29.

The preposition i n- as subject marker. Celtica XI, 61-7.

The influence of Scandinavian on Irish. Proceedings of the Seventh Viking Congress, 75-82.

The Irish numerals of Cardiganshire. Studia Celtica X-XI, 305-11.

Breandán Ó Buachalla:

Modern Irish beirt. Ériu XXVII, 130-4.

Pádraig de Brún:

Irish MSS. in King's Inns Library - addendum. Éigse XVI, 130.

Rolf Baumgarten:

Myles Dillon (1900-1972): A Bibliography. Celtica XI, 1114.

Irish studies theses - 1975. Éigse XVI, 239-42.

Míchéál Ó Siadhail:

Liosta Focal faoi Thógáil Tí as Inis Meáin. Éigse XVI, 75-95.

Fergus Kelly:

The Old Irish Tree-List. Celtica XI, 107-24.

Anne O'Sullivan:

The Tinnakill Duanaire. Celtica XI, 214-28.

Malachy McKenna:

The Breton of Guémené-sur-Scorff, Part I. Zeitschrift für Celtische Philologie XXV, 1-101.

Anders Ahlqvist:

On the Position of Pronouns in Irish. Éigse XVI, 171-6.

John Armstrong:

Phonological Irregularity in the Würzburg Glosses. Ériu XXVII, 48-72.

Liam Ó Murchú:

Review of Eoghan Ó hAnluain's edition of the poems of Seán Ó hUaithnín. Studia Hibernica 15, 199-204.

Pádraig Ó Ciardha:

Review of Ainmhí agus Duine by Tomás Bairéad. Irisleabhar Mhá Nuad 1976, 39-46.

Cecile O'Rahilly:

Cathcharpat Serda. Celtica XI, 194-202.

8. MANUSCRIPT CATALOGUING

The detailed cataloguing of the Irish manuscripts in the National Library of Ireland continued so that now all the manuscripts up to G 176 have been catalogued. Cataloguing of the Irish manuscripts in Cambridge libraries is almost complete. Work on the cataloguing of Irish manuscripts in Scotland is proceeding steadily. Arrangements were made with Rev. P. Ó Fiannachta for the cataloguing of Irish manuscripts in diocesan colleges and in other minor collections throughout Ireland and the first fasciculus - covering the colleges in Kilkenny, Waterford and Fermoy - was completed. Consultations took place with authorities in TCD and UCD with a view to having adequate catalogues of the Irish manuscripts in their libraries published.

III - Annual Report of the Governing Board of the School of Theoretical Physics for the year ended 31 December 1976 adopted at its meeting on 6 April 1977.

1. STAFF AND SCHOLARS

Emeritus Professor:

John L. Synge.

Senior Professors:

John T. Lewis, Director from 1 January 1975; Rev. James R. McConnell; Lochlainn S. O Raifeartaigh.

Visiting Scientists:

G. W. Ford, 9 August - 10 September; P. McGill, 5 July - 27 August; J. Malzan, 10 May - 10 June; M. Muldoon, 14-16 June; M. J. Newell, 13-20 October; R. F. O'Connell, January - August; J. V. Pulè, 9-27 August; J. Rayski, 7 September - 4 October; M. Scheunert, from 1 December; A. Truman, 6-10 December.

Assistent Professors:

W. G. Sullivan, to 30 September; Z. Perjes, from 1 October.

Research Associates:

S. Dineen, D. J. Judge, Rev. D. J. McCrea (UCD); P. S. Florides, B. K. P. Scaife (TCD); A. I. Solomon (Open University); Rev. J. Spelman, D. H. Tchrakian (Maynooth); J. M. Golden (Foras Forbartha); T. Garavaglia (Kevin St. College of Technology); M. J. Conneely, M. J. Newell (UCG); J. R. Saraf (NUU): all appointed to 31 December 1976. P. McGill (UCG),1 January - 31 December.

Scholars:

E. Manoukian, to 31 January; G. Parravicini, S. Browne, D. E. Evans, to 30 September; T. H. Yao, to 31 August; R. Wilson; J. H. Rawnsley, from 1 January; W. Mecklenburg, from 1 October; D. O'Brien, from 1 November.

Research Student without stipend:

B. Goldsmith.

Secretary and Assistant Librarian:

E. R. Wills.

2. GENERAL

A Colloquium on Rotational Brownian Motion was held at DIAS from 23 to 27 August. There were approximately thirty participant mathematicians and physicists, partly from Irish Universities and Colleges, and partly from abroad.

3. STUDY AND RESEARCH

Professor Lewis collaborated with Dr. Evans in work on quantum stochastic processes. This collaboration yielded a number of new results and some new proofs of known results. They began writing an expository account of the subject. Professor Lewis continued his work on the statistical mechanical derivation of the Langevin equation and related matters in collaboration with Dr. J. V. Pulè.

Professors Lewis, McConnell and Ford completed work mentioned in the previous Annual Report on the rotational Brownian motion of a sphere, and extended the treatment to a rigid body with an axis of symmetry. Later Professor Lewis showed how a systematic use of the ideas which had emerged in this work could be used to solve the problem of the rotational Brownian motion of an arbitrary rigid body.

Professor McConnell developed a matrix method for studying polarization effects in dielectrics that arise from rotational Brownian motion of spherical polar molecules. This method reduces the complexity of earlier calculations by Professor R. A. Sack, and extends some of his results. He collaborated with Professor Scaife and Dr. Morita (TCD) in the study of specific mathematical problems in statistical mechanics, and with Professor J. H. Calderwood (Salford) in the study of problems in the conduction of electricity. He also continued his investigations on symmetric functions, in collaboration with Professors H. O. Foulkes (Swansea) and M. J. Newell.

Professor O'Raifeartaigh continued his collaboration with Dr. Parravicini on the investigation of radiative corrections to supersymmetry. They showed that the effective potential, which is used to estimate the radiative corrections, does not alter the supersymmetric structure of the theory. In particular, they showed that any degeneracies which are present in the classical limit are not removed by the radiative corrections. This somewhat surprising result was obtained simultaneously by Capper (Imperial College), Lang (Karlsruhe) and Weinberg (Harvard), using other methods. The application of the effective potential to supersymmetry raised a problem concerning the validity of the standard formalism for certain values of the classical fields. Professor O'Raifeartaigh and Dr. Parravicini investigated this problem; a solution was obtained by replacing the classical fields by certain effective fields.

Professor O'Raifeartaigh's main line of research during 1976 was soliton (finite energy) solutions to classical non-linear gauge theories. Recently, due to the discovery of some special solutions, in particular by 't Hooft and Polyakov, there has been great interest in this field. Professor O'Raifeartaigh worked with L. Michel and K. C. Wali (first at Bures-sur-Yvette, and later at Syracuse) on the problem of finding all soliton solutions for which the radial dependence could be factored. The problem proved very difficult, and the method which finally gave the solution also revealed some new techniques. It was found that the required class of solutions was a slight generalization of the original 't Hooft and Polyakov solution, but containing a mass-formula for mass vs. isospin. The mass formula aside, the result established the effective uniqueness of the original solution under the assumption of radial separation.

Professor O'Connell studied general relativistic effects in binary systems; he also studied atomic spectroscopy in a laser beam.

Professor Sullivan continued his study of stochastic infinite particle systems. He concentrated on considerations of information gain, and the relationship to stochastic differential equations.

Professor Perjes investigated the equations of interacting electromagnetic and gravitational fields in general relativity, assuming that the gravitational field, but not the electromagnetic field, is stationary. Using the SU(2) spin coefficient formalism, which he had previously developed for the subclass of fields where the electromagnetic field is type N (null), he reduced the field equations to a set of partial differential equations in a single complex variable.

Dr. Wilson collaborated with Professors A. O. Barut, A. Inomata and C. K. E. Schneider, and Dr. Tchrakian in research on applications of the concept of internal group dynamics based on the group structures of the non-compact group SO(4,2); they formulated a relativistic quantum theory for the interactions of two scalar particles, studied the electromagnetic structure-properties of hadrons in finite- and infinite-momentum Lorentz frames, and derived a general and closed expression for the oscillator strengths for high level transitions in the hydrogen atom.

During the first part of 1976 Dr. Tchrakian was engaged in the construction of a local-gauge-invariant supersymmetric Lagrangian, using vector superfields. He made a general study of the fundamental aspects of super-fields, and began work, still in progress, on the construction of a new model-supersymmetry, which would allow different masses inside the same superfield. In the second part of 1976 he studied the soliton and instanton solutions of the classical Yang-Mills field equations, and demonstrated the uniqueness of the instanton of Belavin et al.

Dr. Garavaglia continued his investigations on problems in quantum electrodynamics and virtual photon physics. He also continued his research on the electronic properties of macromolecules.

Dr. Golden studied surface contact problems.

Professor Inomata studied the effect of the self-induced torsion of the Dirac sources, via the Einstein-Cartan theory, on gravitational singularities.

Dr. Hobart worked on a modification of Wheeler-Feynman electrodynamics.

Dr. Evans worked in collaboration with Professor Lewis on a C*-algebraic approach to quantum stochastic processes; in particular they studied the construction and dilation of dynamical semigroups on C*- and W*-algebras.

Dr. Rawnsley showed how quantization of a Kähler manifold can give rise to a projective immersion; this should be considered as the globalization to curved phase spaces of the notion of a family of coherent states. He also constructed a pairing of the symplectic spinors of two cleanly intersecting positive polarizations, and showed how to simplify calculations when the polarizations are transverse; using reproducing kernels for harmonic polynomials, he carried out these calculations for the cotangent space of a sphere, and obtained an example of a non-unitary pairing.

Dr. Browne worked with Professor McBrierty (TCD) on some molecular problems associated with the interpretation of N.M.R. data.

Dr. Mecklenburg completed work, commenced before his appointment, on a new application of Zweig's rule. He then studied monopoles in non-abelian gauge theories.

Mr. O. O'Brien worked in elementary particle theory, on monopoles and solitons.

Mr. Goldsmith worked mainly in the field of abelian groups and modules

over complete discrete valuation rings; in particular, he studied endomorphism rings of modules over a complete discrete valuation ring, and a topological approach to a problem of Nunke.

Dr. McCrea, in co-operation with a Ph.D. student, Miss G. O'Brien, continued to investigate the general relativisitic equations of spin recession for a binary star system. Results obtained show a discrepancy with the results of Barker and O'Connell (1975) and of Bőrner, Ehlers and Rudolph (1975); Dr. McCrea and Miss O'Brien are now looking for well-grounded definitions of concepts such as centre of mass momentum and angular momentum of extended bodies in the post-Newtonian approximations to general relativity, with a view to removing ambiguities and uncertainties still remaining in this area.

Dr. Florides worked during the year on the complete field of a general static spherically symmetric distribution of charge; he worked also, in collaboration with a Ph.D. student, K. O'Brien, on charged Einstein clusters and charged perfect fluid spheres.

4. SEMINARS AND REVIEW LECTURES

Review and seminar lectures were held throughout the year, and as in previous years they were attended by members of staff and students from Trinity College, Dublin, University College, Dublin, and St. Patrick's College, Maynooth, as well as by members of the School of Cosmic Physics.

The following review and seminar lectures were given:

Dr. R. H. Critchley (UCC): Entropy density in quantum statistical mechanics.

Dr. S. Gudder (Denver, Colorado): Probability theory and quantum mechanics.

Dr. R. O. Hansen (Math. Inst., Oxford): A complex space for null infinity in general relativity. I.

Angular momentum for relativistic fluid systems.

Dr. A. J. G. Hey (Southampton): General review of SU(6) models and the Melosh transformation algebraic approach.

Dr. P. A. Hogan (TCD): Recent work on the Kerr solution.

Prof. A. Inomata (SUNY at Albany & DIAS): Strong gravity: Hadrons as geometrical objects.

Prof. T. W. B. Kibble (Imperial Coll. London): Spontaneous symmetry breaking and cosmic domain structures.

Dr. P. Krée (Paris VI): Second quantization of sesquiholomorphic functions.

Prof. C. O Ceallaigh (DIAS): Heavy cosmic ray particles and their astrophysical implications (2 lectures).

Dr. J. H. Rawnsley (DIAS): The Kepler problem, motion on a sphere, its quantization and a representation of SO(4,2).

Prof. J. Rayski (Krakow & DIAS): A refined Born approximation.

The problem of localization of energy-momentum and quantization of the gravitational field.

Dr. P. N. M. Sisson (Leuven): The Dicke maser model.

Dr. A. I. Solomon (Open Univ. & DIAS): Is your C*-algebra really necessary?

Dr. D. Szász (Hungar. Acad. Sci.): Infinite particle systems with collisions (2 lectures).

Dr. A. Truman (Heriot Watt, Edinburgh): Aspects of the Feynman path integral in non-relativistic quantum mechanics.

SEMINARS ON THE BONDI-METZNER-SACHS (BMS) GROUP:

Dr. P. A. Hogan (TCD): A geometrical construction of the BMS group in compactified Minkowski space-time.

Dr. G. Parravicini (DIAS): Representations of the BMS group.

Dr. W. Montgomery: Representing supermomenta.

SEMINARS ON TWISTORS:

Dr. Z. Perjes (DIAS): An introduction to flat-space twistors Rest-mass and internal symmetry.

Dr. P. A. Hogan (TCD): The Penrose contour integral.

Dr. L. Castell (Starnberg): Supersymmetry, Twistors, and Urs (A group theoretical approach).

Prof. D. J. Simms (TCD): Twistors and geometric quantization (2 lectures).

SEMINARS ON DIFFERENTIAL EQUATIONS:

Prof. J. T. Lewis (DIAS): The averaging method: Some examples and open problems.

The Wiener integral and the Feynman-Kac formula.

Dr. W. G. Sullivan (UCD): Bogoliubov-Mitropolski averaging method.

Path-space measures and specifications.

Dr. A. Truman (Heriot Watt, Edinburgh): The Feynman integral (3 lectures).

5. COURSES

The course on statistical physics, for beginning graduate students, given in the previous Autumn term by Professor Lewis, was continued and completed; a further course, on Brownian motion, was then given by Professor McConnell. Dr. Evans and Professor Lewis held a research seminar through two terms on quantum stochastic processes (theoretical aspects), and Dr. R. M. Aron (TCD) gave a course on approximation of differentiable functions on a Banach space. In the Autumn term Dr. Rawnsley gave a course on perturbations of periodic Hamiltonian systems, and Professor O'Raifeartaigh gave a course of lectures on solitons and gauge theories.

6. STATUTORY PUBLIC LECTURE

A Statutory Public Lecture under the auspices of the School was delivered by Professor Lewis on 17 December, in Trinity College, Dublin; the title of the lecture was 'Probability in Physics'.

7. COLLOQUIUM

A Colloquium on Rotational Brownian Motion was held in the School from 23 to 27 August. The programme included review lectures, lectures, and a special seminar, as follows:

REVIEWS:

Dr. M. Evans (Aberystwyth): Experimental techniques for measuring orientational functions in liquids.

Prof. J. T. Lewis (DIAS): Mathematical techniques for stochastic differential equations.

Prof. J. R. McConnell (DIAS): Some theoretical approaches to the study of rotational Brownian motion.

Prof. J. G. Powles (Canterbury): Experimental techniques for the study of molecular motions in crystals.

LECTURES:

Dr. M. Evans: The simulation of orientational and cross-correlation functions by a series of memory functions.

Prof. J. G. Powles: Correlation functions and times in liquid nitrogen by experiment and computer simulations.

Prof. B. K. P. Scaife (TCD & DIAS): Comments on some recent work in the theory of stochastic processes.

Dr. G. Wyllie (Glasgow): Brownian rotation and dielectric damping.

Prof. G. W. Ford (Michigan, Ann Arbor): A perturbative technique for Brownian motion of the sphere and symmetrical top (2 lectures).

SPECIAL SEMINAR:

Prof. J. H. Calderwood (Salford): A simple model for electrical conduction in polymers.

Short communications were given by Dr. W. T. Coffey (Salford) (2), Dr. P. Madden (Cambridge), and Dr. A. Morita (TCD). The Colloquium ended with a Discussion, chaired by Professor Ford, on the correlation of theory and experiment in rotational Brownian motion.

8. SYMPOSIA

Two mathematical symposia were held during the year - on 14-15 April and 20-21 December. The attendances (59 in April, 68 in December) included professors, lecturers and graduate students from the several Irish universities, the Colleges of Technology, the NIHE Limerick, and the Regional Technical Colleges.

In addition to the short communications (previews), the following lectures were delivered:

APRIL:

Dr. T. J. Laffey (UCD): Simultaneously triangularizing matrices.

Dr. A. I. Solomon (OU & DIAS): Non-standard analysis - theory and applications.

Dr. P. Dolan (Imperial Coll. London): Covariant gravitation radiation damping.

Prof. E. F. Fahy (UCC): Some aspects of quantization of electric charge, magnetic pole strength, and of electric and magnetic flux.

Dr. M. Newell (UCG): A decomposition theorem for artinian modules.

Dr. M. R. F. Smyth (QUB): The algebraic elements of an algebra.

DECEMBER:

Dr. P. Berner (TCD): (Introduction to) Catastrophe theory.

Dr. R. Bates (Met. Service): Dynamics of planetary-scale standing waves in the atmosphere.

Dr. T. Hurley (UCD): The Jacobi and other identities.

Prof. M. Hayes (UCD): Small vibrations of elastic components.

Dr. B. Quigley (UCD): Stability of functions.

Prof. J. Miller (TCD & Nijmegen): A finite element method for a singularly perturbed differential equation.

9. VISITORS

For lectures given by Visitors, see Sections 4 and 7.

Dr. R. Butler (Manchester) 9-11 February.

Professor J. H. Calderwood (Salford) 23-27 August.

Dr. L. Castell (Starnberg) 24 November.

Dr. R. H. Critchley (Cork) 10-12 March

Dr. M. Evans (Aberystwyth) 23-27 August.

Professor G. W. Ford (Ann Arbor) 9 August - 10 September.

Professor S. Gudder (Denver, Colorado) 6-8 July.

Dr. R. O. Hansen (Oxford) 10-11 February.

Dr. A. J. G. Hey (Southampton) 28 April.

Dr. R. Hobart (Nairobi) 17 February - 10 May.

Professor A. Inomata (Albany) 13 February - 4 May.

Professor T. W. B. Kibble (Imperial Coll. London) 17-18 February.

Professor P. Krée (Paris) 30 November - 1 December.

Dr. O. McBryan (Cornell) 13-24 August.

Dr. P. McGill (Coleraine) 5 July - 27 August.

Dr. J. Malzan (Waterloo, Canada) 10 May - 10 June.

Dr. M. Muldoon (York, Canada) 14-18 June.

Professor M. J. Newell (Galway) 13-20 October.

Professor R. F. O'Connell (Baton Rouge) January - August.

Dr. B. V. Paranjape (Alberta) 13-26 September.

Professor J. G. Powles (Canterbury) 23-27 August.

Dr. J. V. Pulè (Malta) 9-27 August.

Professor J. Rayski (Krakow) 7 September - 4 October.

Dr. M. Schaunert (Bonn) from 1 December.

Dr. P. N. M. Slaeen (Leuven) 22-26 March.

Dr. D. Szász (Budapest) 13-19 May.

Dr. A. Truman (Edinburgh) 1-3 June, 8-10 December.

Dr. G. Wylie (Glasgow) 23-27 August.

10. EXTERNAL ACTIVITIES

Professor Synge lectured in University College Dublin on 9 June on "The American contribution to Science"; this lecture was given as part of the UCD contribution to the American Bicentennial Celebrations.

Professor Lewis and Dr. Browne attended the Dublin IUPAP Conference on "Physics in Industry", 9-13 March. Professor Lewis was guest of the Bolya Mathematical Society in Budapest, 2-8 June, where he lectured on his work on the Langevin equation from the point of view of dilations of contraction semigroups. He represented the School at the Symposium for the 50th anniversary of the Schrödinger Equation, Vienna, 10-12 June, and lectured to the Theoretical Physics Seminar at the University of Vienna on 9 June on Dilations of Dynamical Semigroups. He was an invited speaker at the Conference on Probability and Quantum Theory at the University of Nottingham, 20-23 July. He attended the Statistical Mechanics Conference at the Open University on 5 November, and spoke on Rotational Brownian Motion; he gave a seminar on the same subject during his visit to Oxford, 15-19 November.

Professor McConnell attended a colloquium on dielectrics at the University of Salford, 30-31 March, and lectured on inertial effects in dielectric relaxation. He attended a Table Ronde on Combinatorics and Representations of the Symmetric Group at the University of Strasbourg, 26-30 April, and chaired one of its sessions. From 1-7 May he visited the Max-Planck Institut für Kernphysik, Heidelberg, and gave seminars on topics in Brownian motion at the Universities of Heidelberg and Würzburg. He was appointed visiting professor in the Department of Electrical Engineering of the University of Salford for the 3-year period commencing 1 August, and paid his first official visit there in November.

Professor O'Raifeartaigh completed his year's leave of absence, begun in September 1975, as an invited visiting Professor at the Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette. He attended the Conference on Many Degrees of Freedom in Particle Physics and Field Theory, held at Bielefeld, 23 August - 4 September, and the Voigt Memorial Meeting at Gottingen, 7-11 September; he gave three invited lectures at Bielefeld, and one invited lecture at Gottingen. He also attended the Innsbruck-Karlsruhe Spring School, 10-20 April, where he gave a seminar; he took part, by invitation, in Workshops at CNRS (Marseille), 5-10 July; CERN, 28-30 July; NORDITA, 1-4 December. He paid visits and gave seminars as follows: Karlsruhe University, 21-23 April, one seminar; Louvain-la-Neuve University, 4-7 May, two seminars; Scuola Normale Superiore, Pisa, 25-28 May, two seminars; CERN, 21-25 June, one seminar; Imperial College (London), 26 October, one seminar; Durham University, 27 October, one seminar; Cambridge University, 28 October,

one seminar; Oxford University, 29 October, one seminar; Syracuse University (New York), 14-25 November, one seminar. He gave a seminar at IHES (Bures-sur-Yvette) on 19 May.

Professor Sullivan attended the American Mathematical Society Meeting in San Antonio, Texas, 15 January - 7 February, and then presented talks on Information Gain at Cornell University, the University of Bonn, and the Ecole Polytechnique, Paris. In June he attended the Fourth International Symposium on Information Theory, in Leningrad, and presented a talk on specific information gain for interacting Markov processes. In October he was invited to the Conference on Interacting Particle Systems, at Oberwolfach, Germany.

Professor Perjes attended the Second Advanced Seminar on Relativistic Astrophysics at Erice, 24 November - 3 December, and lectured on the SU(2) spin coefficient method in general relativity.

Professor Scaife attended the Dielectrics Society Conference, Oxford, 6-8 April, and the Engineering Professors' Conference, Warwick, 8-9 April.

Dr. Tchrakian attended the 18th International Conference on High Energy, Tbilisi (Georgia), 15-21 July.

Dr. Garavaglia attended the Winter Meeting on Theoretical Physics, held at the Rutherford Laboratory, 4-7 January.

Dr. Solomon attended the NATO Group Theory Summer School at Montreal, 7 June - 2 July, and the 5th International Colloquium on Group Theory, at Montreal, 5-9 July, where he gave a seminar on the Ising Algebra. He visited the University of Alberta from 12 to 21 August.

Dr. Evans attended the British Mathematical Colloquium, Aberystwyth, in April, and lectured on Dilations of Semigroups on W*-algebras. He also attended the Nottingham Conference on Probability and Quantum Theory, 20-23 July; and he lectured at the Mathematical Institute, Oxford, on 1 March, on Dilations of Dynamical Semigroups.

Dr. Rawnsley attended the Journées Relativistes 1976, in Brussels, 23-25 April; he also attended a Conference on Methods of Differential Geometry in Physics and Mechanics, Warsaw, 14-19 June, and a Meeting on Nonlinear Waves and Solitons, at Newcastle-on-Tyne, 6-9 September.

Dr. Wilson was a visitor at the University of Munich, and at the Max-Planck Institut, Munich, for the months June to August.

Dr. Mecklenburg attended the Rutherford Laboratory Meeting, 15-17 December, and reported on this meeting at the University of Vienna on 20 December.

Professor Inomata attended the Topical Conference on Spontaneous Symmetry Breaking, Trieste, 7-9 April; he gave a lecture on Spontaneous Symmetry Breaking at SUNY at Albany in April.

Dr. Florides lectured in February to the Astronomical Society (UCD) on Einstein's box in the Minkowski world.

11. PUBLICATIONS

Items marked with an asterisk were recorded as in press in previous reports.

(1) Books:

Published:

C. Lanczos:

Space through the ages (Academic Press, 1970) was translated to Hungarian: Budapest, Gondolat, 1976.

J. L. Synge:

Talking about relativity (North-Holland, 1970) was translated to Spanish: Ediciones Universidad de Navarra, S.A.; Baranain, Pamplona, 1976.

J. L. Synge & B. A. Griffith:

Principles of mechanics (3rd edition, McGraw-Hill, 1959) was translated to Kannada: Univ. of Mysore, 1975.

(2) Contributions to periodicals and other publications:

Published:

C. Lanczos & B. Gellai:

*Fourier analysis of random sequences. Computers & Math. Applns. 1, (1976), 269-276.

J. L. Synge:

Eamon de Valera 1882-1975 - elected F.R.S. 1968. Biog. Mems. F.R.S. 22 (1976), 635-653.

J. R. McConnell:

Reminiscences of Eamon de Valera. Included in above, pp. 648-649.

*Cornelius Lanczos in Dublin, 1953-1974. Computers & Math. Applns. 1 (1976), 263-264.

Problems of scientific research in Ireland. Enciclop. '75 (Collab. Cultur. Paesi CEE), Ist. Ital. 1976(?), 225-236.

Note on multiplication theorems for Schur functions. Actes Table Ronde CNRS, Combinatoire et representation du groupe symetrique, Strasbourg 1976, pp. 261-268.

J. T. Lewis, J. R. McConnell & B. K. P. Scaife:

*Relaxation effects in rotational Brownian motion. Proc. RIA 76A (1976), 43-69.

G. W. Ford, J. T. Lewis & J. McConnell:

Graphical study of rotational Brownian motion. Proc. RIA 76A (1976), 117-143.

D. E. Evans & J. T. Lewis:

Dilations of dynamical semigroups. Commun. math. Phys. 50 (1976), 219-227.

L. O'Raifeartaigh:

*Broken gauge and scale invariance. Mathematical Physics and Physical Mathematics, ed. K. Maurin & R. Raczka, Proc. Internat. Sympos. Warsaw 1974, Reidel 1976, pp. 431-440.

L. O'Raifeartaigh & G. Parravicini:

Effective fields and discontinuities in the effective potential. Nucl. Phys. 111B (1976), 501-515.

Effective potential for chiral scalar superfields. Nucl. Phys. 111B (1976), 516-528.

B. Durand & L. O'Raifeartaigh:

*Rapidity amplitudes and their Fourier transforms. Phys. Rev. 13D (1976), 99-103.

G. A. C. Graham:

*Quasi-static crack growth in linear viscoelastic bodies that are acted upon by alternating tensile and compressible loads. Proc. RIA 75A (1975), 263-269.

Extension, torsion and flexure of ageing viscoelastic beams that have two relaxation functions. Bull. Math. Soc. Sci. Math. d. 1. Rep. S. d. Roum. 18 (1974), 283-293. (appeared 1976).

G. W. Ford & R. F. O'Connell:

Atomic ionization potentials in a plane electromagnetic wave. Phys. Rev. 13A (1976), 1281-1282.

W. G. Sullivan:

*Processes with infinitely many jumping particles. Proc. Amer. Math. Soc. 54 (1976), 326-330.

Specific information gain for interacting Markov processes. Z. Wahrscheinlichkeitstheorie verw. Gebiete 37 (1976), 77-90.

J. D. McCrea:

*Static axially symmetric gravitational fields with shell sources. J. Phys. 9A (1976), 697-707.

D. H. Tchrakian:

The vector superfield as an abelian gauge field. Nuclear Phys. 117B (1976), 466-474.

D. H. Tchrakian & P. O'Sullivan:

On the unique mass, definite parity Joos-Weinberg field equations. Acta Phys. Austriaca 45 (1976), 291-295.

G. B. Mainland & E. C. G. Sudarshan:

Poincaré invariance of the spin 3/2 field in the presence of a minimal external electromagnetic interaction. Phys. Rev. 10D (1974), 3343-49.

M. Huq & R. Acharya:

Baryon mass differences in a hybrid gauge model of strong and electromagnetic interactions. Phys. Rev. 11D (1975), 1267-1271.

E. B. Manoukian:

Fundamental identity for the infinite-order-zero nature in quantum electrodynamics. Phys. Rev. 12D (1975), 3365-3367.

Vacuum energy-density in quantum electrodynamics. Fort. d. Phys. 24 (1976), 325-340.

Boundedness of electromagnetic form factors in field theory. Phys. Lett. 62B (1976), 457-459.

S. Browne:

Spontaneous breakdown and finiteness of supersymmetric theories in two dimensions. Phys. Lett. 59B (1975), 253-255.

On the uniqueness of the Lagrangian. J. Math. Phys. 17 (1976), 831-835.

S. Browne & D. Sijacki:

On the irreducible representations of the Lorentz group. Ann. Phys. 99 (1976), 92-126.

D. E. Evans:

Smooth perturbations in non-reflexive Banach spaces. Math. Ann 221 (1976), 183-194.

Time-dependent perturbations and scattering of strongly continuous groups on Banach spaces. Math. Ann. 221 (1976), 275-290.

Scattering in the CAR algebra. Commun. math. Phys. 48 (1976), 23-30.

*Positive linear maps on operator algebras. Commun. math. Phys. 48 (1976), 15-22.

W. T. Coffey & B. K. P. Scaife:

*On the calculation of electric fields in a non-linear dielectric. Proc. Conf. on dielectric materials, measurements, and applications, Cambridge, 1975, IEE Conf. Rep. no. 129 (1975), 111-114.

A. J. O'Connor:

A central theorem for the disordered harmonic chain. Commun. math. Phys. 45 (1975), 63-77.

R. H. Critchley:

On the convergence of the chemical potential. Acta Phys. Austriaca 43 (1975), 321-328.

R. H. Critchley & A. I. Solomon:

*A variational approach to superfluidity. J. Statist. Phys. 14 (1976), 381-393.

In the press:

J. R. McConnell:

Diffusion equation study of rotational Brownian motion. Proc. RIA.

D. E. Evans & J. T. Lewis:

Completely positive maps on the CCR algebra. J. Funct. Anal.

D. E. Evans:

On the spectral type of one-parameter groups on operator algebras. Proc. Amer. Math. Soc.

Unbounded completely positive linear maps on C*-algebras. Pacific J. Math.

L. O'Raifeartaigh:

Gauge and representation independent proof of the Guth-Weinberg theorem. Nuovo Cim. Lett.

W. T. Coffey & B. K. P. Scaife:

On the theory of dielectric saturation of polar fields. Proc. RIA.

(3) Research Reports:

Research work was written up during the year in the first instance as research reports. Two lists of titles of these reports (preprints) were circulated to approximately 100 research institutes and university departments of mathematics and physics, at their request, throughout the world; as far as available copies of these preprints were supplied to research workers in these institutes and departments, on request.

DIAS-TP-76-02: T. H. Yao: A Riemann-Lebesgue theorem for SL(2C).

03: J. T. Lewis, J. McConnell & B. K. P. Scaife: Inertial effects in rotational Brownian motion.

04: D. E. Evans & J. T. Lewis: Dilations of dynamical semigroups.

05: D. J. McCrea: Static axially symmetric gravitational fields with shell sources.

07: D. H. Tchrakian: The vector superfield as an abelian gauge field.

08: D. E. Evans & J. T. Lewis: Dilations of semigroups of completely positive maps on W*-algebras.

09: J. McConnell: Matrix solution of a diffusion equation for dielectric relaxation.

10: B. K. P. Scaife: On the analysis of thermally stimulated depolarization phenomena.

11: B. K. P. Scaife: On the analysis of thermally stimulated depolarization phenomena - a reply to some criticisms.

12: T. H. Yao: A remark on the construction of quantum fields from Markov fields.

13: B. Goldsmith: Endomorphism rings of torsion-free modules over a complete discrete valuation ring.

14: D. E. Evans & J. T. Lewis: Completely positive maps on the CCR algebra.

15: W. Sullivan: Specific information gain for interacting Markov processes.

16: L. O'Raifeartaigh & G. Parravicini: Effective fields and discontinuities in the effective potential.

17: L. O'Raifeartaigh & G. Parravicini: Effective potential for chiral scalar superfields.

18: D. E. Evans: Conditionally completely positive maps on operator algebras.

19: J. L. Synge: Eamon de Valera. 14 October 1882 - 29 August 1975. Elected F.R.S. 1968.

20: D. E. Evans & J. T. Lewis: Completely positive maps on some C*-algebras.

DIAS-TP-76-21: J. McConnell: Diffusion equation study of rotational Brownian motion.

22: T. H. Yao: A 'construction' theorem for 4-dimensional Wightman fields (Note: A conjecture).

23: A. Inomata: Effect of the self-induced torsion of the Dirac sources on gravitational singularities.

24: J. R. McConnell: Note on multiplication theorems for Schur functions.

25: W. Montgomery & A. I. Solomon: Generalized XY model.

26: D. H. Tchrakian: A superfield method for a Fermi-Bose symmetry.

27: B. Goldsmith: A topological approach to a problem of Nunke.

28: D. E. Evans: Smooth perturbations of one-parameter groups on W*-algebras.

29: G. W. Ford & R. F. O'Connell: Atomic ionization potentials in a plane electromagnetic wave.

30: M. Huq & R. Acharya: Baryon mass differences in a hybrid gauge model of strong and electromagnetic interactions.

31: J. Rayski: Eight dimensional unified theory.

32: J. Rayski: The problem of localization of energy-momentum and quantization of the gravitational field.

33: J. H. Rawnsley: Coherent states and Kähler manifolds.

34: J. H. Rawnsley: Transverse pairing of polarizations.

35: J. R. McConnell: Proof of the Littlewood-Richardson rule for the multiplication of Schur functions.

36: L. O'Raifeartaigh: Gauge and representation independent proof of the Guth-Weinberg theorem.

37: P. A. Hogan & D. H. Tchrakian: Initial-value problem for Maxwell and linearised Einstein fields.

38: W. T. Coffey & B. V. Paranjape: Dielectric and Kerr effect relaxation in a strong alternating electric field.

39: D. H. Tchrakian: Uniqueness of the BPST instanton.

40: T. Garavaglia & J. Gomatam: An exact solution of the Schrödinger equation in biconical coordinates.

41: L. Michel, L. O'Raifeartaigh & K. C. Wali: Static finite-energy solutions of gauge fields with separated radial variable.

12. LIBRARY

Approximately 230 new titles were added to the library stock during the year: approximately 200 current periodicals were received, of which almost half were received by gift or under exchange arrangements. The holdings of subscription periodicals were regularly scrutinized with regard to greatest needs, cost, and availability elsewhere in Dublin: a small number of subscriptions was dropped, and a small number of essential new subscriptions was taken up. Contact with the Library of the RIA, the Department of Mathematics and Mathematical Physics at UCD, the School of

Mathematics at TCD, and the Faculty of Science at Maynooth was increased, through the occasional meetings of the mathematical journals committee, where holdings of mathematical journals were discussed. Gifts were received during the year from the University of Hawaii, the Kazakh Institute of Sciences (Alma-Ata), the Stikhlov Institute (Moscow), the University of Durham, ICTP (Trieste), KEK (Japan), the French Government, Professors J. T. Lewis, J. R. McConnell, L. S. O'Raifeartaigh, J. L. Synge, W. Thirring, Drs. I. R. Collinge, S. A. Eberhart, M. G. Murdeshwar, T. H. Yao, and the executors of the late Professor C. Lanczos. Material required by members of the School, but not available in the library, was sought in libraries at home and abroad, and in most cases obtained. Non-members of the School using the Library included members of Departments of Mathematics, Mathematical Physics, Physics, Engineering, Chemistry, and Computer Science of the Irish Universities and technical and technological colleges. The School took part in the National Science Council - Trinity College Dublin National Documentation (Use) Survey, which commenced in October, and will run for six months.

IV - Annual Report of the Governing Board of the School of Cosmic Physics for the year ended 31 December 1976 adopted at its meeting on 20 April 1977.

A. Astronomy Section

1. STAFF AND SCHOLARS

Senior Professor:

P. A. Wayman.

Professor:

T. Kiang.

Research Assistants:

I. Elliott; P. B. Byrne (to 30 September).

Experimental Officer:

B. D. Jordan.

Technical and Clerical Staff:

Miss A. M. Callanan; Mr. R. P. Murphy; Mr. Wm. Dumpleton.

Scholar:

A. E. Lynas-Gray.

The National Science Council of Ireland supported the salary of Dr. P. B. Byrne as a Research Assistant up to 30 September. For the period 1 October to 31 December Dr. Byrne worked on a temporary contract basis.

Professor Kiang and Mr. Jordan were engaged in observational work in Tenerife during the period 11 - 29 January.

Dr. D. K. Yeomans (Jet Propulsion Laboratory, California) worked in the Astronomy Section for three and a half weeks in November.

Mr. T. Ray (TCD) and Mr. E. Rogan (Maynooth) were Vacation Students during July, August and September for eight weeks. Dr. S. M. Plagemann was granted regular use of library and other facilities during the year.

Professor Wayman was elected to the position of Assistant General Secretary of the International Astronomical Union at the XVIth General Assembly of the Union, Grenoble (France), 24 August - 2 September 1976.

Mr. A. E. Lynas-Gray was awarded the Ph.D. degree of the University of St. Andrews (Scotland) in July 1976.

Professor Wayman and Dr. Elliott served on the National Committee for Astronomy throughout the year. In October Professor Wayman was appointed Chairman and Dr. Elliott re-appointed Secretary for the period up to 31 December 1979.

Professor Wayman continues as a member of the Council of the Royal Irish Academy and a member of the Library Committee; also as a member of the Board of Governors of Armagh Observatory.

2. RESEARCH WORK

Photographic Photometry: P. A. Wayman (with C. J. Butler, Armagh and M. J. Stift, Bochum).

The disk files of data on cepheid variable stars in the LMC I region were completed during the year and the material was partly prepared for publication. The task of applying individual colour-corrections, based on the colours of stars implied by regular light curves, using interactive computer program-chains, was completed for 160 cepheids; light curves were also derived for seven eclipsing variables and two long-period variables. 49 of the cepheids are "new" variables, including 30 with periods less than 3.5 days, and the remainder have Harvard Variable designations. Light curves were plotted by graph-plotter at Bochum, Germany, by courtesy of Professor T. Schmidt-Kaler, and preprints by Xerox copy are available for distribution.

The Fourier light curves to the 3rd harmonic appear to represent amplitude of variation reasonably well but hand-drawn light curves have also been prepared. A preliminary comparison of Periods, Magnitudes, Amplitudes and curve-asymmetries shows close agreement with earlier independent results for the cepheid variables in the LMC II region.

In the case of the brighter variables, a detailed comparison with photoelectric results by F. Madore shows close agreement for most of the nine stars in common. The wealth of results available for our fainter variables makes the data virtually unique at the present time, although the new southern hemisphere Schmidt telescopes, coupled with automatic measuring machines, could supplant our results very rapidly. A proposal is in hand for obtaining UK Schmidt (Australia) plates, covering LMC I and LMC II jointly, in order to provide important data on possible small period changes in large numbers of cepheid variables; at present the phases and periods tabulated by C. Payne-Gaposchkin (epoch c.1930) cannot be unambiguously linked with the phases observed by us and the periods deduced from our material (epoch 1967). Further material obtained now will remove such ambiguity and provide data on possible period changes for large numbers of Magellanic Cloud cepheids for the first time.

The general purpose of this material is to assist in the delineation of amplitudes, colours, etc. of stars in or near the cepheid instability strip of the Hertzsprung-Russell diagram and to connect observed properties with theoretical models of stellar oscillation.

Narrow-band Photometry and Galactic Structure: A. E. Lynas-Gray

Intermediate-latitude OB star data were analysed in respect of the possible spiral pattern by projection of estimated stellar distances on to the galactic plane. Similarity with the HI spiral pattern of Kepner and Davies showed a systematic difference consistent with the density wave theory of Lin. The local arm appears to reach 500pc. above the galactic plane and the Perseus arm 1000pc.

Stellar and interstellar (calcium) line-of-sight velocities suggest that these intermediate-latitude spiral features adhere closely to differential galactic rotation, and small departures from this motion exhibit a correlation with possible predictions of the density-wave theory. It was estimated from the observed space motions that only 50% of the intermediate-latitude OB stars have evolutionary lifetimes compatible with their origin being in the galactic plane. Others may have been formed away from the plane in a way connected with infall of extra-galactic material. Gas-to-dust ratios suggest that the proportion of dust decreases systematically away from the galactic plane.

Re-compilation of available data of all known normal intermediate-latitude OB stars was begun in collaboration with D. Kilkenny (St. Andrews). The thesis "An Investigation of Galactic Structure" was completed and submitted successfully for the degree of Ph.D. and the first of several papers on the thesis material was written.

Solar Research: I. Elliott

Analysis of a sequence of 215 Hα chromospheric spectra, represented by more than 3 million density measurements, required transfer *via* 9-track magnetic tape to two Nova disk cartridges, carried out with assistance of computers owned by IBM (Ireland) Ltd., Trinity College, Dublin and Data General (Manchester). Corrections for instrumental effects due to slit width variations and changes in sky transparency were made and density values were reduced to absolute intensity by using standard photo-electric measurements of the solar spectrum. A version of the Maximum Entropy Method for power spectrum analysis was modified for the Nova 2/10 computer enabling the maximum amount of information to be extracted from the data.

Galactic Centre Observations:

The results of observations made in 1971 became of special interest in February 1976 when it was found that the area of observation in which a flashing source of optical radiation was found (30ms. duration at ∿ 10 second interval) includes one of the "burst" x-ray sources discovered during 1975. The consequent possible correspondence between the X-ray source MBX 1743-295 and a source of optical flashes implies the observation of a new class of object. It was found that certain temporal features of the X-ray behaviour are represented also in the anomalous optical flashes and the possible identity was the subject of a note for publication.

Binary X-ray Sources: P. B. Byrne

An investigation of the area of sky contained in and immediately adjacent to the revised error-box for LMC X-4 has revealed several interesting features including a nearby non-thermal radio source embedded in a prominent HII region, as in LMC X-1 and LMC X-5. Further studies are in hand.

Magnetic Variable Stars: P. A. Wayman (in conjunction with M. J. Stift, Bochum).

Using modified Landstreet models, calculations were carried out with a view to finding an oblique rotator model for the star 53 Cam, an outstanding example of a magnetic star which has so far not been successfully described by such a model.

Asteroid Observations: T. Kiang, B. O. Jordan

Using the equipment under the management of Imperial College, London, at Izana Observatory, Tenerife, supplemented by photoelectric equipment assembled specially for the purpose, infrared and optical radiation from asteroids was measured in collaboration with A. D. MacGregor (Imperial College). The 60-inch Flex Collector and standard data-processing equipment secured some sustained runs on asteroids 19 and 29 in spite of extremely difficult observing conditions, and the feasibility of the method was fully demonstrated. The reduction permitted effective size and albedo to be estimated; reports were made to the annual Herstmonceux Conference and at the Wexford meeting of the Institute of Physics.

Interferometric Observations: P. A. Wayman, P. B. Byrne (in collaboration with M. J. Hoey, UCD)

A second observing period, following that of September-December 1975, planned for 1976, was not carried out due to further difficulties with the Spectracon tube, but a tube delivered in July 1976 proved on test to be a marked improvement on previous tubes and has suffered no subsequent deterioration. All relevant items were renovated and checked and are available for use on an ensuing project but it was found impractical to extend the existing period of operation. None of the recorded fringes was reduced so as to give useful scientific results, but the sensitivity of the method and its potential accuracy were carefully investigated.

Halley's Comet: T. Kiang (in conjunction with D. K. Yeomans, J.P.L.).

The orbital elements of Halley's Comet at the last 28 apparitions, obtained in 1971, have been re-examined in respect of correlation between elements. These correlations, including the conspicuous correlation between semi-major axis and eccentricity, can be understood in terms of impulsive perturbations. This understanding gives assurance in extrapolating the values of the elements to a time (7000 years ago or 3000 years hence) when a close encounter with Jupiter is possible. Further extrapolation can only be made in a statistical sense, through numerical experimentation, and a start has been made in this connection.

D. K. Yeomans is undertaking an accurate ephemeris of Halley's Comet in respect of the proposed rendezvous by a space vehicle with the comet in 1986 and he was able to consult directly with Professor Kiang on the present, past and future orbit. Variations in historical times of the cometary tail, and comparisons with dynamical variations, are being studied in a current project.

Statistical Methods: T. Kiang

Frequency distributions in astronomy are generally subject to (i) small sample size and (ii) selectional bias. The limitations depend not only on the quantity of interest - x - but also on some nuisance parameter -u.

Lynden-Bell's "C-Method" was designed to recover the true distribution of x from such a sparsely observed and biased joint distribution of x and u. The C-method has been generalised by Kiang to deal with more than one x and more than one u under certain assumptions regarding selection. The generalised formula is being applied to recover the bivariate distribution of luminosities and diameters of galaxies. Reduction of numerical data is being carried out by S. Plagemann.

3. INSTRUMENTS, ETC.

Photometric Instruments: B. D. Jordan, R. P. Murphy

A modified optical photometer on loan from Armagh Planetarium was mounted at the Cassegrain focus of the 60-inch Flux-Collector on Tenerife (Mt. Teide) and alternating optical and infrared observations were recorded through the same data channel.

Improvements were made to the control electronics of the 2-channel photoelectric photometer to improve reliability. The system is available for use on any suitable telescope and certain possible uses, other than at the Boyden Observatory 60-in. telescope, are being considered.

Substantial modifications to the strength of the Spectracon Fabry-Perot interferometer were made to improve rigidity and to provide a two-axis setting eyepiece.

The axes of the 28-inch telescope were dismounted and tests on the strength are being made in the workshop of Trinity College, Dublin, with a view to designing a modern control system.

An investigation into the feasibility of using microprocessors for a number of future projects was carried out. A Motorola 6800 microprocessor kit was assembled and short trial programs were successfully written. These were: a frequency counter, a 5-digit numerical display and a hexadecimal keyboard controller. A Video Display Unit was constructed from a kit and made suitable for use either with the 6800 Microprocessor or the Nova computer installation. The serial interface and the cursor control had to be substantially modified.

Computer Installation: I. Elliott, B. D. Jordan

The adaptation of Post Office low-speed modems to the leased telephone line from 5 Merrion Square to Dunsink was completed and it has been possible to use the Nova 2/10 successfully with disk operation from the remote terminal in 5 Merrion Square. Certain faults, mostly in the modems, have hindered full use of this facility and steps were taken to instal a new pair of fast modems (1200 baud) in 1977.

For control at the Nova console a new peripheral switching network was designed and constructed, permitting rapid switching of punch, reader, modem, VDU and teletype to or from the Nova 1220 and the Nova 2/10. This equipment and the minicomputers themselves were operated fully during the year with very few faults and many advanced program techniques were employed. Special routines for plotting and polynomial or Fourier curve-fitting were written and used; improvements to FORTRAN and BASIC were made; the operating system was once more updated (to Revision 5.00); a powerful text editor ("Super edit") was added; and a copy of FORTH from the InterAmerican Observatory (Cerro Tololo, Chile) was received via St. Andrews University Observatory.

4. CONFERENCES, LECTURES, ETC.

Professor Wayman, Professor Kiang and Dr. Elliott attended the XVIth General Assembly of the International Astronomical Union at Grenoble, France, 24 August - 2 September. Professor Wayman was elected to the position of Assistant General Secretary at the closing General Assembly; he becomes responsible to the Executive Committee of the Union for the period 1976-79 for details in connection with IAU Symposia, Colloquia and Regional Meetings. For this purpose a separate office system has been set up at Dunsink Observatory.

Contributions were made during the year to the following meetings, conferences, etc.

Irish Astronomical Science Group Meetings of 5 February, 8 June, 20 December.

National Committee for Astronomy Public Film Show to mark Ireland's application for European Space Agency membership. (Films sequenced by Dr. Elliott and Mr. Dumpleton; commentary by Professor Wayman).

University College, Dublin, Extra-mural Lecture series on Astrophysics (arranged by Dr. P. B. Byrne).

Trinity College, Dublin, eight lectures by Professor Wayman on "Radiation in Astrophysics" to 4th-year Physics students.

30-31 March: The Herstmonceux Conference on "Observations from new astronomical instruments" was attended by Professor Kiang and Dr. Byrne.

5-8 April: Professor Wayman attended the Royal Astronomical Society meetings in Manchester.

10-11 April: Professor Kiang contributed to the Wexford meeting of the Institute of Physics, speaking on "Infrared Observations of Asteroids".

17-18 May: Professor Wayman joined a visiting group to the ESTEC establishment of the European Space Agency, arranged by the National Science Council.

1-2 June: Dr. Elliott attended a meeting of the Joint Organization for Solar Observations in Paris as Observer for Ireland.

10-11 June: Professor Wayman attended an ESA meeting in Copenhagen on "Astrometry in Space".

28 June - 9 July: Dr. Byrne attended the Erice (Sicily) meeting on "Transient Sources" as an invited lecturer.

17-20 August: Professor Kiang attended IAU Colloquium No. 39 "Comets, Minor Planets and Meteorites", in Lyon, France.

6-8 Sept.: Mr. Jordan attended IAU Colloquium No. 40 "Linear Image Detectors", in Meudon, France.

6-10 Sept.: Dr. Elliott attended IAU Colloquium No. 36 "The Solar Chromosphere and Corona", in Nice, France.

Dr. Byrne gave lectures to final year Physics students at Maynooth College in November/December and presented the Thompson Lecture of the Regional Technical College, Carlow, in November.

In addition to the above, staff of the Section contributed by way of talks, broadcasts and conducted visits to approximately fifty public or society gatherings during the year.

Visitors to the Section during the year included: Dr. L. B. Lucy, Dr. C. E. Williams, Professor and Mrs. A. B. Meinel, Dr. M. de Groot, President and Mrs. C. Ó Dálaigh, Dr. and Mrs. T. O Raifeartaigh, Dr. J. H. Rodriguez, Professor W. Wright and Professor F. Graham Smith.

The 1976 Annual General Meeting of the Irish Astronomical Society was held at Dunsink Observatory on 25th September.

5. PUBLICATIONS

The following publications relating to the work of the Section are reported:

C. J. Butler:

Photometry of Cepheid Variables in the Small Magellanic Cloud, Astronomy and Astrophysics Supplement 24, 299-356, 1976.

T. Kiang:

Interstellar Absorption and the Luminosity Function of Galaxies, Monthly Notices of the Royal Astronomical Society, 174, 425-428, 1976.

C. J. Butler:

Photoelectric Sequences near the South Galactic Cluster NGC 3532, Monthly Notices of the Royal Astron. Soc. 178, 159-161, 1977.

P. B. Byrne and P. A. Wayman:

Optical Flashes from Burst X-ray Sources, Monthly Notices of the Royal Astronomical Society, 45P-48P, 1977.

P. W. Hill and A. E. Lynas-Gray:

UBV Photometry and MK Spectral Classification of Northern Early-Type Stars at Intermediate Galactic Latitudes, Monthly Notices of the Royal Astronomical Society, in press.

A. E. Lynas-Gray:

An Investigation of Galactic Structure from the Study of Northern Hemisphere Early-Type Stars at Intermediate Galactic Latitudes, Ph.D. Thesis, University of St. Andrews, 1976.

P. B. Byrne:

Binary X-ray Sources, Irish Astronomical Journal 12, 193-203, 1976.

Microprocessors, Technology Ireland, November 1976.

P. A. Wayman:

Magellanic Cloud Cepheids - The Dunsink Programme, Irish Astronomical Journal 12, 82, 1975.

Parsons Telescope, Technology Ireland, January 1977, pp. 38-40.

The following typescripts in A4 format have been given limited circulation:

P. A. Wayman:

October 1975: A Cassegrain Photometer with Automatic Programme.

August 1976: The One-Metre Telescope of the U.K. Science Research Council - A Plan for Irish Participation.

October 1976: Sunrise and Sunset Times and Lighting-Up Times in Ireland for each day in the Years 1977 to 1980.

G. A. Baird, B. McBreen, D. O'Sullivan, A. Thompson and P. A. Wayman:

July 1976: Scientific Liaison with ESA Space Science Department.

6. MISCELLANEOUS

Boyden Observatory:

Ownership of Boyden Observatory was transferred from the Smithsonian Astrophysical Observatory to the University of the Orange Free State on 30 June 1976. The former Boyden Observatory Council was dissolved on that date and funds held in Bank Accounts were transferred to the University. Means for continuing indefinitely the use of the Observatory as an astronomical institution are being sought within South Africa. The ownership of the Armagh-Dunsink-Harvard telescope remains jointly with Armagh Observatory and the Dublin Institute for Advanced Studies and future policy on this ownership is being actively considered, although progress is very slow in reaching a solution to the problems involved.

Proposed Astronomical Institute of the Canary Islands:

Discussions have taken place with the Science Research Council of the United Kingdom concerning possible participation by Ireland in a proposed Spanish International Astronomical Observatory planned for the island of La Palma in the Canary Islands. With the active support of the Irish National Committee for Astronomy and the National Science Council, investigations are in hand in respect of (a) official Irish participation in the above international observatory and (b) a proposal that financial resources be sought equivalent to a 10% share in the ownership and use of a 1-metre reflecting telescope. This instrument is planned to be part of the U.K. installation at the high altitude site Fuente Nueva on La Palma.

B. Cosmic Ray Section

1. STAFF AND SCHOLARS

Senior Professor:

C. O Ceallaigh.

Professor:

K. Imaeda.

Assistant Professors:

D. O'Sullivan; A. Thompson.

Research Assistant:

Y. V. Rao.

Experimental Officer:

J. Daly.

Technical and Clerical Staff:

Miss D. Molloy (resigned 30 June 1976); Mrs. E. Clifton (appointed 1 July 1976); Miss H. O'Donnell; Miss E. Rankin; Miss M. Cahill; Mrs. R. Horan (resigned 12 March 1976); Miss C. Murphy; Miss R. Toner; Miss U. Donnelly (from 6 September 1976).

2. RESEARCH WORK

Charge and Energy Spectra of Cosmic Ray Nuclei

C. O Ceallaigh, D. O'Sullivan, A. Thompson.

The collaboration with Professor Fowler's group at Bristol University continued successfully during the year. Using microdensitometer equipment, detailed ionisation measurements were made on the nuclear emulsion tracks of all the ultra heavy cosmic ray nuclei found in the Cherry Creek stack. In addition, some remaining batches of nuclear emulsion were calibrated by following back Fe-group nuclei from Lexan into emulsion and by carrying out extensive measurements on each track in both Lexan and emulsion.

All the ultra heavy cosmic ray events found to date were re-examined and re-analysed during the year.

Certain changes have been made in the method of analysis. In the earlier work, it had been assumed that the etch-rate V_t could be represented by an equation of the form

$$V_t = aJ^n$$

a and n being constants derived experimentally for each batch of Lexan. The parameter J was derived from the Bethe-Bloch-Sternheimer expression for the restricted energy-loss

$$J = \frac{Z^2_{eff}}{\beta^2} \{K + 2\ln(\beta\gamma) - \beta^2 - \delta(\beta)\}$$

Since it has been observed that for large Z, the best fit was obtained by choosing a value of K = 100 it seemed more meaningful to assume that J was represented by the simpler expression

$$J = \frac{Z^2_{eff}}{\beta^2}$$

In addition the parameter V_t was replaced by the modified parameter G developed by the Bristol-Dublin Collaboration

$$G = (V_t)^{-1} \, d/dr(V_t)$$

All the ultra heavy cosmic ray data have now been transferred to disk storage at Dunsink.

Our earlier material re-analysed combined with our recent events constitutes the world's largest sample of ultra heavy cosmic ray nuclei obtained from thick detectors. The total exposure was 120 m^2 days at $\simeq$ 38 kg m^{-2} atmospheric depth and 284 tracks of nuclei with Z > 34 have been found, of which 97 have Z > 65. The charge distribution shows the peak in the neighbourhood of Platinum predicted by the theory of the rapid process of neutron capture. In addition there appears a high flux of elements in the Uranium group and a marked Actinide gap. The energy spectrum of nuclei Z > 65 was found to be of the form $\gamma^{-1.5}$ thus confirming our earlier results and in sharp disagreement with the spectrum $\gamma^{-3.5}$ proposed by the Berkeley Group.

During the year work began on a project to determine the relative abundances of the elements with $28 \leq Z \leq 36$ in the Cosmic Radiation. At present, world data in the Transcobalt region is very limited. In the case of track detectors the main experimental difficulty involves discrimination against the overwhelming preponderance of the nearby Fe peak. When cylinder scan techniques are set to discriminate completely against Fe-group events, the scanning efficiency for Transcobalt events drops drastically to a few percent. This is an inherent property of the techniques, related to the detector sheet thickness and the variation in zenith angle. In order to overcome this difficulty and collect an appreciable sample of Transcobalt events, a method was developed for distinguishing such events from the Fe peak by means of an ionisation measurement (cone length) at a known residual range. The essential advantage of the method is speed of identification (= 35 events per man-day). Consequently, it has now become possible to extract the elusive Transcobalt events from the various pure Lexan stacks already exposed by the Bristol-Dublin Collaboration and thus recover very valuable information which would otherwise have been lost.

Preliminary results based on a sample of 140 Transcobalt events indicate a Zn/Ni ratio of 0.075 ± 0.02, a larger value than that for the Solar System. For higher charges ($32 \leq Z \leq 35$) there was closer agreement with Solar values but the sample is not yet large enough to draw firm conclusions. It is hoped that further studies in this region can be related to current theories of the nucleosynthesis of Solar System material.

During the year a new collaboration programme was established with the Cosmic Ray Division, Space Science Department of ESA (European Space Agency). It is hoped that joint Dublin-ESA exposures will be made on a new generation of spacecraft which will be launched by the Space Shuttle from 1979. To this end several joint proposals have been submitted to ESA and NASA.

In view of the recent renewed interest in magnetic monopoles it was

decided to set up a Lexan stack at ground level for monopole detection. The stack consisted of six sheets of 250 μm Lexan polycarbonate and had a collecting area of ≈ 100 m^2, divided up into 375 modules. The modules were deployed in the roof space at Dunsink and also at No. 5 Merrion Square. It is intended to employ an exposure of several years so that the area-time factor will be greater than that of the nearest comparable experiment by at least a factor of ten.

Some investigations into the possibility of increasing the charge resolution in Lexan Polycarbonate by the controlled use of ultra-violet radiation were undertaken and are continuing.

The Study of a New Formulation of Classical Electrodynamics

K. Imaeda.

The study of the application of biquaternions to the motion of charged particles in an electromagnetic field has been continued. It is hoped that biquaternions may be used with advantage in a new formulation of classical electrodynamics.

A Study of Quaternions and Tachyons

K. Imaeda.

It has been believed hitherto that supraluminal Lorentz transformations, namely transformations from one system to another moving with a velocity greater than that of light with respect to the first, necessitate the formal introduction of a complex space-time. This concept leads to fundamental changes in the laws of physics about which there is much current controversy.

Study of the problem has led to a new way of formulating a supraluminal transformation which requires neither the introduction of the concept of complex space-time nor of particles different from those the existence of which has already been postulated, namely the bradyon, the luxon and the tachyon.

Multiple Coulomb Scattering of Heavy Ions

Y. V. Rao.

During the year the work on multiple Coulomb scattering of heavy ions has been completed. The scattering constant K has been determined in G5 and K5 emulsions from multiple scattering measurements on beam tracks of 2.1 GeV/amu nitrogen and oxygen ions and 1.05 GeV/amu helium ions. The correlation coefficients for the higher order differences in multiple scattering are shown to be higher than those given in the frame work of Molière's theory. The trend of the increased values of the correlation coefficients is found to be consistent with the calculations of Dada and Rosendorff.

Interactions of 400 GeV Protons with Emulsion Nuclei

Y. V. Rao.

Ilford G5 emulsions were exposed to 400 GeV and 800 GeV proton beams at the National Accelerator Laboratory, Batavia. A total of 300 interactions were detected and analysed. Preliminary results on star size distribution and mean shower multiplicity were obtained. Further analysis of the data is in progress.

3. WORKSHOP AND TECHNICAL DEVELOPMENT - J. Daly.

Apparatus has been constructed to provide uniform high intensity ultra-violet radiation of larger areas of Lexan than hitherto (approximately 0.2 m^2).

The Lexan detectors for the monopole experiment, covering an area of approximately 108 m^2 and consisting of a total of 375 stacks each containing six sheets have been prepared and with the kind permission of Professor Wayman the major portion (stacks No. 29 - 375) was installed in the roof-space of Observatory House at Dunsink. The remainder (stacks No. 1 - 28) has been installed in the Library of No. 5 Merrion Square. These will remain exposed for a number of years.

The usual maintenance work on the equipment used within the section was also carried out during the year.

4. COMPUTING FACILITIES

The planned link between No. 5 and the Data General Configuration at Dunsink is in operation and has been used successfully throughout the year.

5. EXTERNAL ACTIVITIES

Following Ireland's accession to membership of the European Space Agency, Professors D. O'Sullivan and A. Thompson visited ESTEC (the space research centre of the European Space Agency at Noordwijk, The Netherlands) during May 1976 as members of the first official academic delegation from Ireland. The visit was sponsored by the National Science Council.

Professors C. O Ceallaigh, D. O'Sullivan and A. Thompson attended the 9th International Conference on Solid State Nuclear Track Detectors at Neuherberg/München, Germany (30 September to 6 October 1976). Recent results of the Bristol-Dublin Collaboration were presented.

Several working visits by members of the Academic and Technical Staffs were made to the Physics Department, Bristol University, during the year in furtherance of the Bristol-Dublin collaboration.

Members of the Academic staff paid further visits to the European Space Agency centres in Noordwijk and Paris in furtherance of the Dublin-ESTEC Collaboration.

The Heavy Ion Conference in Predeal, Romania, was attended by Professor D. O'Sullivan in August.

As a member of the Scientific and Technical Committee of Euratom and one of its representatives on the Groupe de Liaison Fusion, Professor O Ceallaigh attended meetings at Jülich, Germany (22-23 March 1976) and Brussels, Belgium (26-27 October 1976). As a member of the CST Committee he attended meetings at Brussels, Belgium on 20 February, 21 April and 28 September 1976. As a member of the SC Committee of CERN he attended meetings at Geneva on 8 March, 20 September and 7 December 1976.

Members of the Cosmic Ray Group attended the International Conference on Physics in Industry organised by IUPAP and the Royal Irish Academy. Professor O Ceallaigh acted as chairman of the final session. He attended all meetings of the National Committee for Physics as a representative of the Dublin Institute for Advanced Studies.

6. COURSES AND LECTURES

Professor O Ceallaigh gave two seminars at the School of Theoretical Physics, 10 Burlington Road, on the Nucleonic Charge Spectrum of Primary Cosmic Rays and its connection with Modern Astrophysics. Professor O'Sullivan delivered a series of 18 lectures on Nuclear and High Energy Physics to final year physics students at University College, Galway, during Trinity Term.

7. PUBLICATIONS

Published:

C. O Ceallaigh, D. O'Sullivan and A. Thompson:

High Resolution study of Nucleonic Cosmic Rays with $Z \geq 34$. Proceedings of the 9th International Conference on Solid State Nuclear Track Detectors, Neuherberg/München, Germany, September/October 1976.

Measurement of the Cosmic Ray Element Abundances between ≈ 300 and ≈ 750 MeV/N in the region from Nickel to Krypton using Lexan Track Detectors. Proceedings of the 9th International Conference on Solid State Nuclear Track Detectors, Neuherberg/München, Germany, September/October 1976.

Production of Nuclear Fragments from the Interactions of 24 GeV/c Protons in a Cold Target. Nuovo Cimento 33A, 487 (1976).

K. Imaeda:

A New Formulation of Classical Electrodynamics. Il Nuovo Cimento 32B, 138 (1976).

On "Quaternionic Form of Supraluminal Transformations". Lettere al Nuovo Cimento 15, 91 (1976).

Y. V. Rao:

Rising inelastic cross section and its contribution to steepening of the cosmic ray energy spectrum. Annalen der Physik 33, 99 (1976).

Coulomb scattering parameters in emulsions exposed to high energy heavy ion beams. Bull. American Phys. Soc. 21, 527 (1976).

Multiple Coulomb scattering of heavy ions in emulsions. Nuclear Instruments and Methods 138, 383 (1976).

Some aspects of 400 GeV proton interactions in nuclear emulsions. Paper presented at the 9th ICNTD, Munich, October 1976.

In Preparation:

K. Imaeda:

Tachyons and Complex Space-Time.

C. Geophysics Section

1. STAFF AND SCHOLARS

Senior Professor:

T. Murphy.

Professor:

A. W. B. Jacob (from 1 October 1976).

Research Assistant:

Vacant.

Experimental Officer:

J. C. Davies (from 27 September 1976).

Technical and Clerical Staff:

K. Bolster; Miss A. Byrne; Miss E. Ryan; Miss V. Ward; G. Wallace.

Scholar:

D. W. Howard.

Field Assistant:

P. Murphy (from 21 June to 13 August 1976).

2. RESEARCH WORK

(a) Gravity:

General regional surveys were carried out in Co. Wexford by Misses Ryan and Ward and in Co. Cork by Misses Ryan and Ward and Davies and Howard. Detailed work was also carried out in the latter area across the Lee Valley west of Cork city together with some magnetic profiles. This valley, according to our findings, marks an abrupt change in the geological basement beneath the Carboniferous and Devonian strata. The results are being prepared for publication.

(b) Magnetics:

Further to the study of the magnetic field over the Continental shelf some data was put at our disposal by a hydrocarbon prospecting company and this only confirmed last year's findings of the impossibility at present of combining magnetic results from different surveys. The company in question had requested assistance in interpreting magnetic records and this we were able to give but in view of the above difficulties the interpretation could only be classed as provisional. The problem probably could be resolved by taking more detailed surveys with far higher navigational accuracy. The magnetic readings themselves on all occasions are accurate enough.

At the request of the E.S.B., in conjunction with the Geological Survey, a marine magnetic survey was carried out off Carnsore Point in May. The

vessel used was a chartered fishing vessel Shelmalier and the equipment, a Varian marine magnetometer, was very kindly lent to us by the University of North Wales. As this work was new to crew and operators efficiency was not achieved until late in the cruise. The results delineated the extent of the PreCambrian rocks around Carnsore Point and demonstrated the advantages of the magnetic method in the work. An important finding was made further to the west where the results would indicate that the coast of Waterford from Stradbally to Tramore forms a northern edge of a graben structure hitherto unsuspected. Preparation of publication is in hand. During this work a continuous recording of the magnetic flux was made in the grounds of Rosslare Observatory. We would like to thank the Meteorological Office and the staff of the Observatory for their cooperation. A limited ground survey was also carried out over the Carnsore Granite and nearby. Anomalies encountered reached 1000 nT. The sources were not identified.

In July and August in cooperation with the Geological Survey three cruises in the Lough Beltra, a fishing vessel recently acquired by the National Science Council, were undertaken. An area about 10 kilometres wide from Skerries to Bray was surveyed with the magnetometer. The results are being prepared for publication.

Dr. Howard further investigated by a detailed survey and drilling the area north of New Ross where strong magnetic anomalies were encountered last year. His findings are of commercial interest and may help to explain a series of other similar anomalies in the southeast of Ireland.

He analysed the magnetic anomaly zone in the Strokestown area and attributed it to two sources, one deep (ca. 2 km), the other close to the surface. The latter is very probably mafic volcanics with high susceptibility values (20,000 S.I.). These volcanics are interpreted as the result of island arc activity along a subduction zone which is suggested from this and other work to extend from Belfast Lough to Galway Bay.

Palaeomagnetic measurements carried out on two sills within limestone in the Strokestown area, hitherto unmapped and brought to his notice by Dr. Sevastopulos, yielded a Tertiary age. This result broadens the known extent of Tertiary activity in Ireland.

(c) Meteorology:

Routine observations of the meteorological elements were continued throughout the year, autographic records tabulated and the results published. Averages of meteorological charts have been brought up to date, namely, Rainfall 1941-1970, Temperature 1931-1960 and Sunshine 1931-1960, and are ready for publication.

(d) Seismology:

Seismic recording equipment (paper and magnetic tape) was received towards the end of the year and a systematic testing of possible sites for seismometers within 50 km of Dublin was undertaken. The intention is to set up a tripartite array of at least D30 30 km spacing. The background noise, seismic and electric, of the sites within 20 km of the city centre seems so far to be too high for our purposes.

3. LECTURES AND FIELD EXERCISES

The series of eight weekly lectures on geophysics for geological students from the Universities was given during Michaelmas Term. Students from the two Dublin and the Cork Colleges attended. The numbers were up to twenty.

The field geological exercise for Trinity College students took place in the Ox Mountains around Lough Talt. Magnetic and gravity anomalies were traced out in particular and the use of various geophysical equipment demonstrated.

A lecture to engineering, geology and physics students was given in University College, Cork followed by a demonstration of geophysical techniques over a gravel deposit being exploited commercially by the firm of John A. Wood Ltd. At this site it was found that the gravity method gave good results but the seismic and electrical methods failed. Subsequent investigation has revealed that the nature of the deposit, coarse gravel, is responsible. The subject is being studied.

4. EXTERNAL ACTIVITIES

Professor Murphy attended the following meetings:

(a) The European Society of Exploration Geophysicists, The Hague, June 1-4.

(b) The European Geophysical Society, Amsterdam, September 7-10.

5. STATUTORY PUBLIC LECTURE

The Statutory Public Lecture, entitled 'Some recent developments in forensic seismology' was given by H. I. S. Thirlaway of Procurement Executive, Ministry of Defence, Blacknest, U.K. on 10 December 1976 in Trinity College, Dublin.

6. PUBLICATIONS

D. W. Howard and G. Wallace:

Rock Susceptibility Meter. Jl. of Physics E: Scientific Instruments, Vol. 9, 1976.

D. G. G. Young:

A geophysical interpretation of the structural development of the Kingscourt graben. Proc. RIA, Vol. 76, Section B, No. 3, 1976.

W. E. Phillips, C. J. Stillman and T. Murphy:

A Caledonian plate Tectonic Model. Jl. Geol. Soc. Lond., Vol. 132, 1976.

INSTITIÚID ARD-LÉINN BHAILE ÁTHA CLIATH
(Dublin Institute for Advanced Studies)

Income and Expenditure Account

for the year ended 31 December 1976

1975		NOTES	1976
£	INCOME		£
462,790	Oireachtas Grants in Aid	1(a), 2	553,500
10,372	Sales of Publications	3	11,216
1,500	Grant from Sir John Galvin		---
40	Grant from Bord Fáilte Éireann		---
1,612	Miscellaneous	4	2,783
476,314			567,499
	EXPENDITURE	5	
95,800	Administration		117,228
120,901	School of Celtic Studies		135,390
72,862	School of Theoretical Physics		77,836
163,371	School of Cosmic Physics		201,587
1,410	Adaptation of Premises		10,707
454,344			542,748
21,970	SURPLUS for the year	6	24,751

Notes 1 to 10 form part of these accounts

Signed: W. B. Stanford

W. B. STANFORD
CHAIRMAN - COUNCIL OF THE INSTITUTE

14th July, 1977.

INSTITIÚID ARD-LÉINN BHAILE ÁTHA CLIATH
(Dublin Institute for Advanced Studies)

Balance Sheet at 31 December 1976

1975			1976
£	CURRENT ASSETS	NOTES	£
51,618	Cash on hands and at bank		73,626
11,957	Debtors and Prepayments		12,049
63,575			85,675
	Less		
	CURRENT LIABILITIES		
18,025	Creditors and accruals		15,374
45,550	NET CURRENT ASSETS		70,301
	Represented by		
45,550	INCOME and EXPENDITURE - Accumulated Surplus	6	70,301

Notes 1 to 10 form part of these accounts

Signed: W. B. Stanford

W. B. STANFORD
CHAIRMAN - COUNCIL OF THE INSTITUTE

14th July, 1977.

INSTITIÚID ARD-LÉINN BHAILE ÁTHA CLIATH
(Dublin Institute for Advanced Studies)

NOTES TO THE ACCOUNTS

1. Accounting policies

(a) Oireachtas Grants-in-Aid: Income shown in the Accounts as Oireachtas Grants-in-Aid is the actual cash received in the period of the Account.

(b) Furniture and Equipment: Expenditure on Furniture and Equipment is written off in the period in which it is incurred.

(c) Publications: Expenditure on Publications is written off in the period in which it is incurred.

1975 £	2. Oireachtas Grants-in-Aid	£	£
105,250	Administration	120,400*	
108,600	School of Celtic Studies	129,000	
74,190	School of Theoretical Physics	80,700	
172,000	School of Cosmic Physics	217,400	
2,750	Adaptation of Premises	6,000	553,500
462,790			

*£4,500 was transferred from Administration to Adaptation of Premises.

£	3. Sales of Publications	£	£
9,805	School of Celtic Studies	11,148	
390	School of Theoretical Physics	(8)	
177	School of Cosmic Physics	76	11,216
10,372			

£	4. Income		£	£
211	Miscellaneous:	Administration	1,563	
267		School of Celtic Studies	70	
118		School of Theoretical Physics	50	
20		School of Cosmic Physics	1,100	
996		Adaptation of Premises	--	2,783
1,612				

INSTITIÚID ARD-LÉINN BHAILE ÁTHA CLIATH
(Dublin Institute for Advanced Studies)

NOTES TO THE ACCOUNTS

5. Analysis of Expenditure

1975		Total	Administration	School of Celtic Studies	School of Theoretical Physics	School of Cosmic Physics
£		£	£	£	£	£
266,983	Salaries, Wages & Superannuation	308,101	56,358	82,193	47,093	122,457
20,197	Scholarships	26,226	-	9,413	11,834	4,979
3,226	Visiting Lecturers	2,628	-	-	2,398	230
2,600	Honoraria	3,100	-	3,000	-	100
15,274	Library	19,689	-	1,476	7,396	10,817
34,517	Publications (Note 1(c))	39,539	376	34,961	3,164	1,038
22,886	Furniture & Equipment (Note 1(b))	33,804	2,429	421	725	30,309
45,642	General Administration (Note 7)	56,038	56,038	-	-	-
13,611	Travelling & Survey Expenses	18,486	124	2,175	2,198	13,989
191	Conway Centenary Expenses	-	-	-	-	-
2,865	Symposium & Seminar Expenses	876	-	100	776	-
12,992	General Expenses	14,164	1,903	1,651	2,252	8,358
4,613	Special Commitments (Note 8)	2,233	-	-	-	2,233
7,337	Consumable Equipment & Materials	7,077	-	-	-	7,077
452,934	Sub-Total	532,041	117,228	135,390	77,836	201,587
1,410	Adaptation of Premises	10,707				
454,344	Total	542,748				

Expenditure of £2,801 which was incurred by the School of Cosmic Physics on a research project and which is being funded by grants from the National Science Council, is not included in these Accounts.

6. Surplus/Deficit Position

	Balance 1/1/76	Year to 31/12/76	Balance 31/12/76
	£	£	£
Administration	12,542	4,735	17,277
School of Celtic Studies	3,715	4,828	8,543
School of Theoretical Physics	2,247	2,906	5,153
School of Cosmic Physics	22,564	16,989	39,553
Adaptation of Premises	4,482	(4,707)	(225)
	45,550	24,751	70,301

This surplus is available towards meeting the Institute's expenditure on commitments outstanding at 31 December 1976 (see Note 10).

7. General Administration Expenses

1975		
£		£
25,776	Rents, Rates & Insurance	33,538
5,994	Premises Maintenance	6,059
4,868	Postage & Telephones	6,468
8,315	Fuel, Light & Power	9,214
689	Sundry Supplies	759
45,642		56,038

INSTITIÚID ARD-LÉINN . BHAILE ÁTHA CLIATH
(Dublin Institute for Advanced Studies)

NOTES TO THE ACCOUNTS

1975	8. Special Commitments	£
£		
4,113	Contribution to Boyden Observatory 1976	2,233
500	Balloon Flight - Part cost for transporting equipment to and from USA	-
4,613		2,233

9. Superannuation

Expenditure arising under superannuation schemes is met out of Oireachtas Grants-in-Aid in the year of payment.

10. Outstanding Commitments

The estimated cost of commitments outstanding at 31 December 1976 exclusive of Current Liabilities shown on the Balance Sheet, is as follows:

31/12/75		
£		£
9,176	Administration	17,178
3,927	School of Celtic Studies	8,464
2,719	School of Theoretical Physics	5,156
29,592	School of Cosmic Physics	40,584
4,000	Adaptation of Premises	-
49,414		71,382

AUDITOR'S REPORT

I have examined the foregoing Income and Expenditure Account and Balance Sheet which, as required by Acht um Institiúid Ard-Léinn 1940, are in the form approved by the Minister for Education with the concurrence of the Minister for Finance. I have obtained all the information and explanations which I considered necessary for the purpose of my audit.

In my opinion:-

(a) proper books of account have been kept by An Institiúid and the Income and Expenditure Account and Balance Sheet are in agreement with them,

(b) The Income and Expenditure Account and Balance Sheet, together with notes 1 to 10, give, respectively, a true and fair view of the transactions of An Institiúid for the year ended 31 December 1976, and of the state of its affairs on that date.

SEÁN MAC CEAPAILT
Comptroller and Auditor General.
4 August, 1977.